Can Changing Economic Incentives Explain the Rise in Obesity?

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Abstract

A growing body of research examines the effects of economic variables on obesity, but the papers in this literature typically focus on only one or a few factors at a time. We aim to build a comprehensive economic model of body weight, combining individual-level survey responses from the 1990-2010 waves of the Behavioral Risk Factor Surveillance System with 27 state-level variables related to general economic indicators, labor supply, and the monetary or time costs of calorie intake, physical activity, and cigarette smoking. We develop a data-driven process to determine which of these economic factors belong in the empirical model, and then estimate their effects on body mass index, obesity, and severe obesity controlling for demographic characteristics and state and year fixed effects. Changes in these economic variables collectively explain 27% of the rise in body mass index, 32% of the rise in obesity, and 62% of the rise in severe obesity. Supercenter/warehouse club expansion and increasing numbers of restaurants are the two leading drivers of these results. We also conduct falsification tests showing little connection between economic factors and use of seatbelts or preventive health care, consistent with a causal interpretation of the effects on weight.

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I. Introduction

Obesity, defined as having a body mass index (BMI) at least 30, leads to adverse health conditions such as heart disease, diabetes, high blood pressure, and stroke (Strum, 2002).[1] The adult obesity rate in the United States has skyrocketed from 13% in 1960 to 34% in 2008, with most of this increase occurring since 1980 (Flegal et al., 1998; National Center of Health Statistics, 2008). Obesity has become a major public health and public finance concern. Estimates of its annual costs include 112,000 lives and $190 billion, with about half of the medical expenses borne by Medicare and Medicaid (Flegal et al., 2005; Cawley and Meyerhoefer, 2012; Finkelstein et al., 2003).

This trend has prompted economists to ask whether obesity can be considered an economic phenomenon involving individuals' responses to incentives. More specifically, technological progress has resulted in an environment in which food is cheaper and more readily available, while physical activity is increasingly easy to avoid. If people respond predictably to incentives, these changes could help to explain the rise in population weight. In their seminal paper, Philipson and Posner (1999) formalize this notion by modeling weight as the result of eating and exercise decisions made through a utility-maximization process.[2] Individuals trade-off the disutility from excess weight with the enjoyment of eating and having a sedentary lifestyle, subject to a budget constraint. The model predicts that lower food prices and reduced on-the-job physical activity should increase weight, while the effect of additional income on weight varies across the income distribution. Cutler et al. (2003) point out that time costs of eating could matter in addition to monetary costs, and discuss how innovations such as vacuum packing, improved preservatives, and microwaves have reduced the time cost of food

[1] BMI=weight in kilograms divided by height in squared meters.
[2] The paper was later published as Philipson and Posner (2003), but we focus on the working paper version as it contains a more detailed model.

preparation. Later theoretical models (e.g. Komlos, 2004; Ruhm, 2012; Courtemanche et al., 2012) add an intertemporal dimension, noting that the enjoyment from eating and sedentary activities occurs in the present but the health costs occur in the future. The prediction that the weights of at least some individuals should respond to economic incentives persists in these models, regardless of whether or not preferences are time inconsistent.

Motivated by these theoretical considerations, a large number of empirical studies estimate the links between various economic factors and obesity.[3] Lakdawalla and Philipson (2002) document an inverted U-shaped association between income and BMI in individual fixed effects models. Lindahl (2005) and Cawley et al. (2010) find no evidence that income affects weight using lottery prizes and variations in Social Security payments as natural experiments, while Schmeiser (2009) finds that Earned Income Tax Credit benefits increase weight. Ruhm (2000 and 2005) provides evidence of an inverse relationship between state unemployment rates and BMI. Several papers document a connection between food prices and BMI, including Lakdawalla and Philipson (2002), Chou et al. (2004), Lakdawalla et al. (2005), Goldman et al. (2011), and Courtemanche et al. (2012). Others study the role of restaurants, with Chou et al. (2004), Rashad et al. (2006), Dunn (2008), and Currie et al. (2010) finding a positive relationship between restaurant prevalence and energy balance but Anderson and Matsa (2011) finding no evidence of a connection using a different methodology. The influence of cigarette prices on energy balance has also received considerable attention. Chou et al. (2004), Baum (2008) and Rashad et al. (2006) estimate that higher cigarette prices increase obesity, but Gruber and Frakes (2006) and Nonnemaker et al. (2008) find that this result disappears using different

[3] A separate but closely related literature studies how economic factors affect childhood obesity. Since our study focuses on adult obesity, we do not discuss this literature here. See Anderson and Butcher (2006) for a survey of this literature, and Cawley and Ruhm (2011) for a more detailed discussion of both the adult and childhood obesity literatures.

methodologies, while Courtemanche (2009b) and Wehby and Courtemanche (2011) suggest the long-run relationship might actually be negative. A number of studies investigate whether food stamps lead to obesity, finding mixed results (Baum, 2011; Beydoun et al., 2008; Chen et al., 2005; Fan, 2010; Gibson, 2003 and 2006; Meyerhoefer and Pylypchuck, 2008; Kaushal, 2007; and Ver Ploeg et al., 2007). Another frequently studied potential economic cause of obesity is urban sprawl. Ewing et al. (2003) and Frank et al. (2004) document an association between sprawl and obesity, but Plantinga and Bernell (2007) and Eid et al. (2008) show that at least part of this association can be attributed to reverse causality. Most recently, Zhao and Kaestner (2010) find that sprawl increases weight using an instrumental variables approach. Other aggregate-level trends linked to the rise in adult obesity by at least one study include lower time costs of food preparation (Cutler et al., 2003), reduced on-the-job physical activity (Lakdawalla and Philipson, 2002 and Lakdawalla et al., 2005), longer work hours (Courtemanche, 2009a), falling gasoline prices in the 1980s and 1990s (Courtemanche, 2011), and the proliferation of Walmart Supercenters (Courtemanche and Carden, 2011).

These papers in the economic causes of obesity literature generally examine only one or a few factors at a time. The literature therefore lacks a clear answer to the big-picture question of how well "the economic explanation" of people responding to changing incentives can explain the rise in obesity. Simply adding the percentage of the trend explained by separate studies of each potential contributor is unlikely to produce a reliable answer to this question. First, many of the economic variables discussed above are likely correlated (e.g. different types of prices, densities of different types of stores), in which case including only a subset of them might lead to omitted variable bias. Second, Chou et al. (2004) – a widely-cited source of information about the effects of restaurants, grocery food prices, restaurant prices, alcohol prices, cigarette prices, and clean indoor air laws – do not control for time, which could bias their estimators given the strong upward trend in weight.[4] Third, even if the estimates from the literature are all causal, the fact that the economic factors often influence each other may lead to double counting of their contributions to the rise in obesity. For instance, number of stores selling food likely affects food prices, so if one study estimates the effect of food stores while another estimates the effect of food prices, the portion of food stores' impact that occurs via food prices will be double counted. Other examples include the influences of restaurant density on restaurant prices, gas prices on urban sprawl, and income on various aspects of the built environment. To underscore our point, Table 1 shows that adding estimates from the literature suggests that economists have already explained 177% of the rise in average BMI.

This paper aims to develop a comprehensive reduced-form model of weight that includes numerous economic factors reflecting the economic incentives alleged to have contributed to the upward trend in weight in the U.S. We combine individual-level survey data from the 1990-2010 waves of the Behavioral Risk Factor Surveillance System with state-level variables reflecting general economic conditions, labor supply, and the monetary or time costs of eating, physical activity, and smoking. Factors related to general economic conditions include unemployment rate, median income, and two measures of income inequality: the ratios of the 90^{th} to 50^{th} and 50^{th} to 10^{th} percentile of the earnings distribution. Our labor supply variables are female and male labor force participation rates, average work hours, and proportions of physically active and blue collar jobs. Economic factors influencing the monetary or time costs of caloric intake include restaurant, grocery food, and alcohol price; relative price of fruits and

[4] Indeed, if we estimate their model with our data (through 1999, the last year of their sample period), adding year fixed effects substantially attenuates the estimates. Appendix Table 1 reports these results. Chou et al.'s (2004) omission of year fixed effects has been previously criticized by Gruber and Frakes (2006) and Nonnemaker et al. (2009).

vegetables to other foods; restaurant, supercenter/warehouse club, supermarket, convenience store, and general merchandiser densities; and food stamp spending. Variables influencing the monetary or time costs of physical activity are gasoline price, fitness center density, and a proxy for urban sprawl: share of residents living in central cities of metropolitan statistical areas (MSAs). Cigarette price and smoking bans in private workplaces, government workplaces, restaurants, and other locations are our variables related to the money or time costs of smoking.

Starting with these 27 economic factors, we implement a data-driven process to select the variables that belong in the final specifications. We then estimate the associations between these variables and BMI, obesity, and severe obesity, conditional on demographic controls as well as state and year fixed effects. Changes in these economic factors collectively explain 27% of the rise in body mass index, 32% of the rise in obesity, and 62% of the rise in severe obesity. Supercenter/warehouse club expansion and increasing numbers of restaurants are the two leading drivers of these results. The decline in blue-collar employment and the rise in food stamp benefits also appear to have contributed to the upward trend in weight, while increased access to fitness centers and higher gasoline prices have worked against the trend. Our conclusions are broadly similar if we include all 27 economic factors together in the same model, or if we include lags to address the dynamics of weight accumulation. Finally, we conduct falsification tests showing little connection between economic factors and use of seatbelts or preventive health care, consistent with a causal interpretation of the effects on weight.

II. Analytical Framework and Econometric Model

We begin by developing a simple analytical framework for body weight and by discussing the predicted impacts of the economic factors that we will include in the regression analysis. Weight (W) is a function of caloric intake (I), caloric expenditure (E), and metabolism (M):

$$W = w(I, E, M) \tag{1}$$

Greater caloric intake increases weight, while greater caloric expenditure and a faster metabolism reduce weight. Smoking's (S) effects on weight are multifaceted. Nicotine stimulates the metabolism and also has appetite-suppressing properties that may reduce caloric intake, but smoking diminishes lung capacity which may reduce physical activity (Courtemanche, 2009b). Caloric intake, exercise, and smoking are in turn influenced by various economic factors including sets of variables related to their monetary and time costs ($\boldsymbol{C_I}$, $\boldsymbol{C_E}$, and $\boldsymbol{C_S}$) as well as general economic ($\boldsymbol{G}$) and labor market ($\boldsymbol{L}$) characteristics. Therefore,

$$I = i(\boldsymbol{C_I}, \boldsymbol{G}, \boldsymbol{L}, S) \tag{2}$$

$$E = e(\boldsymbol{C_E}, \boldsymbol{G}, \boldsymbol{L}, S) \tag{3}$$

$$M = m(S) \tag{4}$$

$$S = s(\boldsymbol{C_S}, \boldsymbol{G}, \boldsymbol{L})\,. \tag{5}$$

Plugging equations (2) through (5) into (1) yields

$$W = w\big(i(\boldsymbol{C_I}, \boldsymbol{G}, \boldsymbol{L}, s(\boldsymbol{C_S}, \boldsymbol{G}, \boldsymbol{L})), e(\boldsymbol{C_E}, \boldsymbol{G}, \boldsymbol{L}, s(\boldsymbol{C_S}, \boldsymbol{G}, \boldsymbol{L})), m(s(\boldsymbol{C_S}, \boldsymbol{G}, \boldsymbol{L}))\big). \tag{6}$$

which simplifies to the reduced-form equation

$$W = w(\boldsymbol{G}, \boldsymbol{L}, \boldsymbol{C_I}, \boldsymbol{C_E}, \boldsymbol{C_S}). \tag{7}$$

Estimating the full structural model in (6) with a large number of aggregate-level economic factors is not currently practical with available data. Datasets that contain sufficient sample sizes to simultaneously analyze the effects of many state-level economic variables (namely the BRFSS) do not have adequate information on the mechanisms (eating, exercise, and/or smoking) through which these variables influence weight, while datasets that contain adequate information on the mechanisms (e.g. the National Health and Nutrition Examination Surveys) are too small. Our empirical analysis will therefore focus on the estimation of the reduced-form model given by (7).

Assuming a linear functional form for (7) yields the estimating equation

$$W_{ijt} = \beta_0 + \boldsymbol{\beta_1 G_{jt}} + \boldsymbol{\beta_2 L_{jt}} + \boldsymbol{\beta_1 C_{Ijt}} + \boldsymbol{\beta_2 C_{Ejt}} + \boldsymbol{\beta_3 C_{Sjt}} + \boldsymbol{\beta_4 X_{ijt}} + \alpha_j + \tau_t \qquad (8)$$

where *i*, *j*, and *t* index individuals, states, and years. *W*=BMI, a dummy for obesity (BMI≥30), or a dummy for severe obesity (BMI≥35).[5] $\boldsymbol{X}$ is a set of controls that includes individual age and age squared; dummies for gender, race/ethnicity (black, white, Hispanic, or other), marital status (single, married, divorced, or widowed), and education (less than high school degree, high school degree, some college, or college degree); as well as state population.[6] α_j and τ_t are state and year fixed effects.

$\boldsymbol{G}$ consists of four variables reflective of general state economic characteristics: unemployment rate, median income, and the ratios of the 90th to the 50th and the 50th to 10th percentiles of the earnings distribution.[7] [WE NEED TO ADD DISCUSSION OF THEORETICAL EFFECTS OF THESE VARIABLES.]

$\boldsymbol{L}$ consists of five state-level variables related to labor supply: female and male labor force participation rate, average work hours among employees, proportion with a job that

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[5] We have verified that our conclusions are similar if we use logits or probits for the binary dependent variables rather than linear probability models. We prefer to present the linear probability model results as they are easier to interpret.
[6] We control for population because some of our economic incentive variables are per capita, and we want to ensure that any estimated effects of these variables can be attributed to the numerator rather than the denominator. We control for unemployment rate because Ruhm (2000, 2005) has documented the procyclicality of BMI. Regardless, our results are similar if we exclude the state-level controls.
[7] The BRFSS does contain a variable for respondents' household income, but it only gives broad categories and is top-coded at $75,000. Because of the top-coding, inflation-adjusting this variable suggests that average real income dropped by over 20% during our sample period, which is inconsistent with other data sources and might therefore misleadingly suggest that changes in real income have substantially contributed to the obesity trend. We therefore control for income at the state level rather than the individual level. It is unlikely that this would bias our coefficient estimates for the regressors of interest since they are also state level. Indeed, these estimates are very similar if we use the BRFSS individual income measure rather than median state income.

requires at least moderate physical activity (defined as a metabolic equivalent (MET) score of 3 or higher), and proportion of the workforce in blue collar occupations (construction, manufacturing, or extraction). The first three of these relate to theory that more market works tightens the time constraint, perhaps leading to either less exercise or substitution from home-cooked meals to less healthy pre-prepared foods. This theory is particularly salient in light of the rise in female labor force participation during the 20th Century that was only partially offset by a decline in male labor force participation (Anderson et al., 2003; Courtemanche, 2009a). The latter two variables relate to the notion that the shift from a manufacturing-based economy to more sedentary jobs may have reduced overall levels of physical activity, as one must now exercise during leisure time (Philipson and Posner, 2003; Lakdawalla and Philipson, 2005). The proportion in active jobs variable captures this hypothesis most directly, whereas the proportion in blue collar occupations variable may also capture other aspects of such jobs – e.g. their relatively rigid structure which may inhibit on-the-job snacking or going out for lunch.

$\boldsymbol{C_I}$ includes several state-level variables related to the monetary or time costs of calories. These variables are included to test perhaps the most commonly accepted theory for the rise in obesity: that food became cheaper and more readily available during the 20th Century, increasing caloric intake and therefore weight. The first three variables in this category are restaurant, grocery food/non-alcoholic drink, and alcohol prices. At first glance, lower prices for foods or drinks should increase weight via the usual law of demand. However, substitution across different types of foods/drinks needs to also be considered. For instance, if the price of grocery food falls while the price of restaurant meals stays the same, individuals might substitute away from restaurant meals toward home-cooked meals, which might reduce weight since home-cooked meals are presumably healthier. Similar logic applies if the prices of certain types of grocery foods fall further than others. To that end, our fourth variable in this category is the relative price of fruits and vegetables to other grocery foods. Next, we include per capita food stamp spending, which effectively lowers the price of food for recipients out to a certain threshold. Our variables related to the time cost of obtaining food are per capita numbers of restaurants, supercenters/warehouse clubs, supermarkets, convenience stores, and general merchandisers. Greater availability of these stores means a shorter travel time to obtain food, presumably increasing weight. However, substitutability matters here as well. For instance, the food sold in conventional supermarkets may be on average healthier than food sold at the other places. A rise in supermarket density could therefore reduce weight by causing, for instance, people to buy their groceries there rather than at convenience stores. Food store availability could also influence monetary prices, either through competitive effects or, in the case of supercenters/warehouse clubs, by selling food at deep discounts (Courtemanche and Carden, 2011).

$\boldsymbol{C_E}$ includes three state-level variables: gasoline price, fitness centers per capita, and share of residents living in central cities of MSAs. Higher gasoline prices increase the opportunity cost of driving relative to walking, bicycling, or taking public transportation, effectively reducing the opportunity cost of physical activity (Courtemanche, 2011).[8] An increase in fitness center density lowers the time cost of exercising. Share of residents living in central cities proxies for urban sprawl.[9] More sprawl (fewer residents in central cities) typically means fewer amenities accessible through walking or mass transit, increasing the opportunity cost of caloric expenditure (Zhou and Kaestner, 2010).

[8] Courtemanche (2011) notes that higher gasoline prices could also reduce weight by causing less eating out at restaurants.

[9] We also considered several other proxies for urban sprawl, such as population-weighted population density, and share of the population living in counties with various density cutoffs.

Finally, C_S includes state-level cigarette price and dummies for smoking bans in private workplaces, government workplaces, restaurants, and other locations. Cigarette prices capture the monetary cost of smoking, while smoking bans affect the time cost since smokers have to go outside to smoke more often (Chou et al., 2004).

III. Data

Our source of individual-level data is the BRFSS, a telephone survey of the health conditions and risky behaviors of randomly-selected individuals conducted by state health departments and the Centers for Disease Control. The BRFSS began in 1984, but we use the years 1990-2010 to match the years in which all of our state-level economic factors are available. As discussed in the introduction, the sharp rise in obesity began around 1980, so our sample includes two-thirds of the period during which weights rapidly increased. Following Gruber and Frakes (2006), we exclude individuals over age 64 out of concerns that the regression function for weight for the elderly is likely quite different than that for working-age adults, and that mortality is most clearly endogenous to weight for the elderly, which has implications for the makeup of the sample. The BRFSS includes self-reported height and weight. We apply a percentile- based correction to adjust for systematic reporting error, and use the "corrected" heights and weight to compute BMI and indicators for obesity and severe obesity. [ADD MORE DETAIL.] The BRFSS also includes demographic information that we use to construct the individual-level control variables discussed above. Finally, the BRFSS contains questions on seatbelt use and four types of preventive medical care – well-patient checkups, flu shots, mammograms, and prostate screenings – that provide dependent variables for falsification tests.

Our price data come from the Council for Community and Economic Research's (C2ER) Cost of Living Index (formerly known as the ACCRA Cost of Living Index). The C2ER Cost of

Living Index computes prices for a wide range of grocery, energy, transportation, housing, health care, and other items in approximately 300 local markets per quarter throughout the US. Most of these local markets are single cities, but some are combinations of cities while others are entire counties. Following Chou et al. (2004), for each market we average over the prices of each item in the given category (e.g. grocery foods), weighting by the C2ER shares of each item's importance in the basket of goods. We then define state prices as the population-weighted average of the prices in the state's C2ER markets. Finally, we convert prices in all years to 2010 dollars using the consumer price index for all urban consumers from the Bureau of Labor Statistics.

We use data from the Quarterly Census of Employment and Wages (QCEW) for the numbers of restaurants, supermarkets, convenience stores, and general merchandisers in each state. The data are collected by the BLS with the cooperation of the state agencies that manage the UI system, and cover the establishments that employ 98% of all workers. (In our industries, it captures the universe of establishments.) The only missing values are due to BLS disclosure rules that protect confidentiality in small cells, which results in only a few deleted state-by-year cells in our case. Restaurants include both fast food and full service; we have also tried modeling these two categories separately but are unable to reject the hypothesis that the effects of both types are the same.[10]

The QCEW information on supercenters and warehouse clubs is missing for many observations, so we construct this variable ourselves by updating the primary data collected by Courtemanche and Carden (2011) through 2008. The key limitation of this variable is that it only captures Walmart Supercenters, Sam's Clubs, Costcos, and BJ's Wholesale Clubs. It does not, for instance, include K-Mart or Target Supercenters. However, Walmart is by far the

[10] Chou et al. (2004) also added fast-food and full-service restaurants together for the same reason.

dominant supercenter chain, while Sam's Club, Costco, and BJ's Wholesale Club are the only three major warehouse chains currently operating in the U.S. We considered modeling Walmart Supercenters and warehouse clubs separately but were unable to reject the hypothesis that their effects are the same.

The other state-level variables come from various sources. Median income, unemployment rate, female and male labor force participation, and proportion of the workforce in a physically active job come from the Bureau of Labor Statistics (BLS). The United States Department of Agriculture provides information on Supplemental Nutrition Assistance Program (food stamp) benefits. Population and share of the population living in MSA central cities are taken from the U.S. Census Bureau. Cigarette prices, inclusive of state and federal excise taxes, come from *The Tax Burden on Tobacco* (Orzechowski and Walker, 2010).[11] Finally, we construct dummy variables reflecting the extent of state clean indoor air laws using data from Impacteen and the classification scheme of the 1989 Surgeon General's Report (U.S. Department of Health and Human Services, 1989). The data come from a combination of the 1989 Surgeon General's Report and Impacteen.

[WE NEED TO ADD DISCUSSIONS OF 90/50 RATIO, 50/10 RATIO, AVERAGE WORK HOURS, PROPORTION ACTIVE JOB, AND PROPORTION BLUE COLLAR.]

Combining all of these sources yields a final analysis sample of 2,922,071 individual observations. Tables 2-7 provides further descriptions of the variables, gives their summary statistics, and reports their means in the first and last years of the sample. From 1990 to 2010, average BMI rose from 26 to 28.5, the obesity rate rose from 18% to 34%, and the severe obesity rate rose from 7% to 14%.

[11] *The Tax Burden on Tobacco* reports prices both including and excluding generic brands. Following Chou et al. (2004), we use the series excluding generics to allow for greater comparability across the sample period.

Figures 1-10 show trends over our sample period in the economic factors. The only variables steadily trending in the direction in which economic theory would predict that they could have meaningfully contributed to the rise in obesity are restaurant density, supercenter/warehouse club density, proportion of the workforce in a blue collar job, cigarette price, and smoking bans.[12] Other variables – proportion central city, proportion active job, female labor force participation, restaurant price, and food stamp spending – exhibit a trend that on net works in the direction of the trend in obesity, but it is uneven throughout the sample period. Since the trend in weight is relatively steady, it seems unlikely that these variables could be more than minor contributors to the rise in obesity. Gasoline price and fitness center density exhibit trends that should theoretically work against the trend in weight.[13] We observe trends in income inequality during the sample period – namely, the middle of the income distribution losing ground against both the bottom and the top – that could have either increased or reduced obesity. The remaining variables do not seem to exhibit trends that would make it possible for them to have meaningfully impacted the weight distribution in either direction. Of particular interest is the lack of a downward trend in grocery food prices, arguably the economic factor most widely believed to have helped cause the obesity epidemic. Ruhm (2011) observes the same phenomenon with BLS food price data. However, the C2ER and BLS both exclude supercenters and warehouse clubs, which sell food at deep discounts (Courtemanche and Carden, 2011). Since the prevalence of supercenters/warehouse clubs has been rapidly increasing, as shown in Figure 8, it is possible that our supercenter/warehouse club variable might better

[12] We also decomposed the proportion of the workforce in a blue collar job variable into separate variables for manufacturing, construction, and extraction, finding that the entire decline is driven by manufacturing. All three components appear to have similar effects on weight, however, so we elect to combine them.
[13] Courtemanche (2011) notes that real gasoline prices fell during the 1980s and 1990s, in contrast to the pattern we observe post-2000. It is therefore that changes in gasoline prices might have contributed to the increase in obesity during the earlier stages of the rise, but worked against the trend in the later stages. This would imply, however, that other factors dwarf the influence of gasoline price.

capture the changes in food-at-home prices during our sample period than our grocery food variable.

IV. Results

We report the results from estimating four variations of the regression given by equation (8). We estimate multiple models because of an inherent trade-off between reducing omitted variable bias and minimizing multicollinearity. Presumably including all the economic factors together would minimize the extent of omitted variable bias (though this is not automatically true if some of these variables are endogenous and bias spills over to the other coefficients). On the other hand, given the correlations between many of the economic factors, including them all could lead to such severe multicollinearity that the resulting coefficient estimates are too imprecise to be useful.[14] We therefore estimate variations of the model that make different choices regarding these tradeoffs and examine the ways in which the results are similar or different across specifications.

First, we run regressions of BMI, obesity, and severe obesity on each economic variable separately, conditional on the controls and state and year fixed effects. Second, we use the data to select which economic factors "belong," and include them together in one regression that we refer to as containing "surviving economic factors only." This is our preferred specification, as it balances the concerns about of multicollinearity and bias through a data-driven process. The process involves four steps:

1) Select the economic factors that are either statistically (10% level or better) or economically significant in the separate regressions, where economic significance is defined as having effects of one standard deviation increases of at least 0.05 units BMI,

[14] Indeed, Chou et al. (2004) use this rationale to justify excluding time trends from their model.

0.5 percentage points P(Obese), and 0.3 percentage points P(Severely Obese).[15]

2) Re-include any excluded variable that meets the criteria of statistical or economic significance if the "surviving" economic factors are added to the model.

3) Run a regression including the "surviving" variables from step 1 and the others added in step 2, and drop any that are no longer either statistically or economically significant.

4) Re-estimate the model including only the new set of "surviving" variables from step 3.

Next, our third model simply includes all 27 economic incentive variables, without regard to whether they are statistically or economically significant. This is the exact model given by equation (8).

Finally, the fourth regression uses a data-driven process to allow for the inclusion of lags of the economic factors. This addresses the possibility that, since weight is a capital stock accumulated over time, the short- and long-run effects of changing economic incentives could differ. It is not clear which of these our fixed effects estimates with contemporaneous economic factors more closely reflect.[16] We begin with the "surviving economic factors" model discussed above. For each economic factor, we add one annual lag and compute its "total effect" as being the sum of the coefficients on the contemporaneous and lagged variable. If this total effect differs from the original estimate by more than one standard error, we select the specification with one lag as the new default. We then consider a second lag through the same process, and then a third lag. For each factor we consider at least three lags; in cases where the third lag changes the total effect by more than a standard error, we consider a fourth lag, and so on. We

[15] We choose these cutoffs to roughly coincide with the smallest effect sizes for which we would generally observe statistical significance for most variables, based on the standard errors. In unreported regressions we have considered various alternative cutoffs and the conclusions reached are very similar.

[16] We have also considered other approaches to modeling dynamics, including adding one, three, or five lags for all variables, as well as aggregating the data to the state level and estimating dynamic panel models. The conclusions reached are the same as our present approach – namely, that modeling dynamics does not seem to make a clear difference in the results.

repeat this process separately for each of the 27 economic factors. Our final model then consists of all the variables from the "surviving economic factor" specification plus any previously excluded ones whose total effects now meet the aforementioned criteria for statistical or economic significance.

Tables 8-10 display the regression results for each of the three dependent variables. We report the effects of one standard deviation increases in the economic factors, as opposed to coefficient estimates, in order to allow comparability of the magnitudes. (The coefficient estimates can be computed by dividing the reported effects of one standard deviation increases by the standard deviations given in the summary statistics tables.) For the regression with lags, we report total effects and denote the number of lags chosen in the superscripts.[17] Tables 11-13 then computes the percentage of the increases in average BMI, the obesity rate, and the severe obesity rate explained by changes in each economic factor, along with subtotals for each category and a grand total from all factors. The last row of Tables 11-13 shows the percentages explained collectively by all the changes in the control variables; results for each control variable are available upon request.

Effects of One Standard Deviation Increases

Table 8 reports the effects of the economic factors on BMI. Running separate regressions for each economic factor suggests that a number of these variables are associated with BMI, sometimes in surprising ways. Income inequality, food prices, supermarket density, gasoline price, fitness centers, cigarette prices, and restaurant smoking bans are all statistically significant and negatively associated with BMI. Convenience store density, proportion blue collar, and proportion central city are also inversely related to BMI and economically (though not

[17] Results for the individual lags are available upon request, though they are not especially informative because of severe multicollinearity across the lags. The total effects are much more precisely estimated.

statistically) significant according to our prior definition. On the other hand, greater supercenter/warehouse club and general merchandiser densities, more food stamp benefits, and miscellaneous smoking bans all lead to either statistically or economically significant weight gains.

Implementing the data-driven selection process to incorporate the economic factors together into one regression changes the results dramatically, eliminating some of the effects, attenuating others, and causing a couple new ones to emerge. The two income inequality variables, grocery prices, general merchandisers, cigarette prices, and smoking bans all fail to make the final model, suggesting that their estimated associations with BMI in the single-economic-factor regressions may have been plagued by omitted variable bias. The magnitudes of the effects of proportion blue collar, supercenters/warehouse clubs, supermarkets, convenience stores, food stamp benefits, gasoline prices, fitness centers, and proportion central city all shrink but remain either statistically or economically significant with the exception of convenience stores. Interestingly, in all cases the standard errors actually shrink after including the other economic factors, so the attenuation of the estimates does not appear to be attributable to multicollinearity. Median income, alcohol price, and restaurant density are now associated with statistically significant increases in weight despite being originally insignificant. Their estimates also become more rather than less precise after including the other economic factors.

Including all 27 economic factors together in the same regression leads to broadly similar results as the "surviving economic factors" approach. The only change in statistical or economic significance is that gasoline price becomes marginally economically insignificant rather than marginally economically significant. None of the point estimates change by even as much as one standard error. None of the variables excluded from the "surviving economic factors" regression emerge as being statistically or economically significant with all the variables included. In all but two cases, the standard errors are smaller than from the separate one-factor-at-a-time regressions, again underscoring the point that multicollinearity does not appear to be a justification for examining each economic factor separately.

The last column of Table 8 adds the lags, which ultimately does not have much influence on the results. Only in three cases do the data select any lags: one for 50/10 ratio, three for grocery food price, and three for fitness centers. The only variable to become statistically or economically insignificant as a result of adding lags is grocery food price. None of the other estimated total effects change by even as much as a standard error relative to either the "surviving factors" or "all factors together" regressions. Since the regression with lags requires discarding the first three years of data, inflates most of the standard errors, and does not seem to have much impact on the estimated total effects, our preferred specification remains the one from the data-driven process with only contemporaneous economic factors.

Table 9 displays the impacts of one standard deviation increases in economic factors on P(Obese). As with BMI, we observe a number of significant associations when running separate regressions for each economic factor that disappear when the variables are included together. We therefore focus our discussion on the final three columns. Only five economic factors make it into the "surviving factors only" regression. $50^{th}/10^{th}$ percentile earnings ratio and supermarket density are negatively associated with BMI, while restaurant, supercenter/warehouse club, and general merchandiser densities are positively associated with BMI. Including all 27 economic factors together leads to similar results. Only one previously excluded variable is statistically significant: miscellaneous smoking bans now increase BMI, but the effect is small. The point estimates and significance levels for the variables included in the "surviving economic factors" regression remain similar. Adding lags has very little impact on the results. The only notable difference is for proportion in a physically active job, for which three lags are included and the total effect becomes negative and marginally statistically significant.

Table 10 reports the results for P(Severely Obese). We again focus our discussion on the last three columns. Seven variables survive the data-driven model selection process: proportion in blue collar jobs, supermarket density, and proportion living in a central city all reduce severe obesity, while restaurant, supercenter/warehouse club, and general merchandiser densities and food stamp benefits all increase severe obesity. The point estimates for these variables are all similar once the other 20 economic factors are added in the "all factors together" regression, while no new factors are statistically significant. Adding lags leads to a few meaningful differences. The $50^{th}/10^{th}$ percentile earnings ratio, grocery food price, and fitness center density becomes statistically or economically significant and negatively associated with severe obesity, while the (already small) effect of general merchandisers disappears.

Percentage of Rise in BMI Explained by Changes in Economic Factors

The next three tables use the estimates from these regressions to compute the percentage of the increases in average BMI, obesity, and severe obesity during our sample period 1990-2010 that can be attributed to changes in economic factors. For each economic factor, we multiply its coefficient estimate by the change in its sample mean from 1990 to 2010, divide by the change in the dependent variable from 1990 to 2010, and then multiply by 100%. For the regressions with lags, 1993 is the start year and we incorporate changes in the lags in addition to changes in the contemporaneous values.[18] We then add the percentages to compute totals for each category of

[18] If, for instance, grocery food price is included with three lags, the percentage of the rise in BMI attributable to the change in grocery food price is equal to [(mean price in 2010-mean price in 1993)*coefficient for price + (mean price in 2009-mean price in 1992)*coefficient for lagged price + (mean price in 2008-mean price in

economic factors and for all 27 economic factors together. For comparison purposes, we also perform an analogous calculation for the percentage of the rises in BMI, obesity, and severe obesity attributable to changes in the control variables. (Due to space considerations we do not report the results for each control variable separately; these are available upon request.)

Table 11 reports the percentage calculations for the rise in BMI. Again we see the potential for combining estimates from separate regressions for each economic factor to lead to misleading results. According to the "separate regressions" column, changes in variables related to the costs of calorie intake explain almost 40% of the rise in average BMI from 1990 to 2010, but changes in variables related to the costs of exercise and smoking offset almost this entire amount. The general economic and labor supply variables contribute a small amount to the upward trend, bringing the total explained by all changing economic factors together to 9.5%. As seen in the next three columns, combining the economic factors together into one regression eliminates many of the results working against the trend and changes the overall conclusions dramatically. In the "surviving economic factors" model, changing economic factors collectively explain 27% of the rise in BMI. Changes in the variables related to costs of calories account for more than this entire amount – 34.9%. Changes in factors related to costs of physical activity offset 8.3% of the trend, while changes in general economic indicators and labor supply variables contribute less than 3% and none of the smoking variables even make it into the regression. Turning to the specific economic factors, the proliferation of supercenters/warehouse clubs alone explains 17.8% of the rise in BMI, while restaurant expansion explains another 12.6%. The next most substantial contributors are the rise in food stamp benefits at 3.6% and the declining proportion of blue collar workers at 2.4%. Changes in median income, alcohol price,

1991)*coefficient for the second lag of price + (mean price in 2007-mean price in 1990)*coefficient for the third lag of price] / (mean BMI in 2010 – mean BMI in 1993) * 100%.

and proportion central city contribute very small amounts to the upward trend in BMI. Higher gasoline prices and fitness center expansion are the only two forces working against the trend in any meaningful way. As shown in the last two columns of the table, the regressions with all 27 economic factors together and adding lags lead to very similar results.

Table 12 turns to the percentage of the rising obesity rate that can be explained by changing economic factors. Again we focus our discussion on the calculations using the "surviving economic factors" regression, as the results from the regressions with "all economic factors together" and adding lags are generally similar, while the separate regressions again clearly lead to misleading results. Together, changing economic factors explain 32.2% of the rise in obesity. This is almost entirely driven by changes in the variables related to the costs of calories, which collectively explain 30.1%. The role of changes in the costs of calories is in turn attributable almost entirely to supercenters/warehouse clubs and restaurants, which explain 18% and 10.5% of the rise in obesity respectively. The declining earnings gap between the middle and lower classes explains another 2.1% of the trend, while none of the labor supply, physical activity-related, or smoking-related variables make it into the model.

Table 13 presents the estimates for severe obesity, again focusing on the calculations using the "surviving economic factors" regression. Changing economic factors collectively explain 61.7% of the rise in severe obesity – a much greater portion of the trend than for BMI and obesity. This is an important result, as the severe obesity threshold is the point where the mortality consequences of excess weight begin to emerge (Flegal et al., 2013). [WE NEED TO DO MORE TO MAKE THE CASE THAT SEVERE OBESITY IS ESPECIALLY IMPORTANT, PERHAPS ALSO ADDING SOMETHING IN THE INTRO.] Changes in factors related to the costs of calories explain 54.8% of the rise in severe obesity, while the shift away from blue collar jobs contributes another 5.5% and the movement away from central cities adds another 1.4%.[19] Among the variables related to the costs of calories, supercenters/warehouse clubs and restaurants are again the most important, explaining 27.5% and 18.5% of the rise in severe obesity, respectively. Increased food stamp benefits add 7.2%, while more general merchandisers contribute another 1.8%. The conclusions reached are again broadly similar in the regressions with all 27 economic factors and with lags, so we do not discuss them in detail. The most substantial difference is that adding lags causes a negative contribution of fitness center expansion to the severe obesity trend to emerge, reducing the overall contribution of economic factors by a few percentage points.

VI. Falsification Tests

An important question regarding the preceding set of results is the extent to which the estimated effects of the economic factors on BMI, obesity, and severe obesity can be considered causal. At issue is whether unobservable characteristics are correlated with the economic factors even after controlling for the demographic controls and state and year fixed effects. In other words, are changes over time in unobservable state-level characteristics correlated with changes over time in the state-level economic variables? We argue that including so many economic factors together reduces this possibility, at least relative to the less comprehensive approaches typically used in the literature. However, it is difficult to rule out all potential identification

[19] It is interesting that proportion of blue collar workers influences severe obesity (and to a lesser extent average BMI) while proportion in a physically active job does not. This suggests the effect of blue collar employment is due to some other aspect of these jobs besides their presumably higher levels of activity. One possibility is that they tend to have more rigidly structured work days than white collar or service jobs, with fewer opportunities for on-the-job snacking or going out to lunch. In unreported regressions (available upon request), we found some preliminary support for these hypotheses. Using data from the American Time Use Survey, we find a negative association between having a blue collar job and time spent in secondary eating. Using data from the DDB Needham Life Style Surveys, we estimate a negative association between blue collar employment and frequency of eating lunch at restaurants, but no effect on frequency of eating out other meals. This may be an interesting hypothesis to further explore in future research.

problems in the absence of a natural experiment, and obviously finding natural experiments for 27 different variables is not practical in our case. We therefore attempt to mitigate concerns about omitted variable bias through a series of falsification tests.

Ideal dependent variables for falsification tests in our context would satisfy two criteria: 1) there should not be any reason for them to be causally affected by the economic factors, and 2) they should be influenced by the same unobservable characteristics as body weight. Natural candidates to satisfy the second condition are other health behaviors, as presumably they are also affected by obvious potential unobservable confounders such as state residents' demand for health, health knowledge, and time and risk preferences. However, it is difficult to find other health behaviors that perfectly satisfy the first condition, given the wide scope of the economic factors included in our analysis. The best candidates available in the BRFSS are dummies for whether the respondent always uses a seatbelt, went to the doctor for a preventive checkup (e.g. physical) in the past year, had a flu shot in the past year, and had a mammogram (for women) or digital rectal prostate exam (for men 40 and older) in the past two years.[20] One might still be concerned that the medical care variables could depend on insurance, which could depend on income, income inequality, labor force participation, or work hours. However, these economic factors were not among the more important ones in our weight regressions, so they will not be focal points of the falsification tests.

Table 14 reports the results from linear probability models regressing each of these five dependent variables on selected economic factors, as well as the demographic controls and state and year fixed effects. We do not want to include all 27 economic factors together in the

[20] The BRFSS specifically imposed the age restriction for men's prostate exams, but not for women's mammogram's, so we follow their lead and include women of all ages. The results are similar if we impose various age cutoffs for women. The BRFSS also includes information on a second type of prostate screening – the Prostate-Specific Antigen (PSA) test – but this test is controversial so we do not include it.

falsification tests, as this might create multicollinearity problems that reduce the power of the tests – an issue that could be especially important here as the sample sizes for our tests are all at least somewhat reduced. We instead include only those economic factors that explained at least 3% of the rise BMI, obesity, or severe obesity in our preferred “surviving economic factors” specification (or worked against the trend by the same magnitude). This narrows the list of economic factors to proportion blue collar, restaurant density, supercenter/warehouse club density, food stamp benefits, gasoline price, and fitness center density.

As the table shows, there is little evidence that these variables are associated with any of our placebo outcomes. The economic factor that performs the worst in these tests is fitness center density, which is positively associated with seatbelt use, doctor checkups, and mammograms. These results suggest that the number of new fitness centers opening in a state might be influenced by changes over time in the state’s level of health consciousness, which could mean their estimated effects on weight are biased downward. However, since fitness center expansion worked against the trends in BMI, obesity, and severe obesity, this suggests that if anything our estimates for the percentages of their trends explained by economic factors are conservative. The only other variable that is significant in any of the falsification tests is restaurant density, which is positively associated with prostate exams (but none of the other four outcomes). Again, however, any spurious *positive* association of restaurants with demand for health would suggest that our results for weight are conservative. In sum, there is no evidence in Table 14 to suggest that our conclusion regarding the share of the rise in obesity that can be attributed to changing economic factors is too strong.

[WE ALSO NEED TO COME UP WITH SOME WAY TO TEST FOR REVERSE CAUSALITY. WE HAVE TRIED ADDING LEADS OF THE ECONOMIC FACTORS BUT

THEY ARE TOO HIGHLY CORRELATED WITH CONTEMPORANEOUS FACTORS FOR THE RESULTS TO BE INFORMATIVE.]

VII. Heterogeneity

[WE WILL STRATIFY THE SAMPLE TO SEE WHETHER THE EFFECTS DIFFER BY SEX, RACE, AND EDUCATION. WE WILL ALSO SEE WHETHER THE EFFECTS DIFFER ACROSS THE BMI DISTRIBUTION VIA QUANTILE REGRESSION.]

VIII. Discussion

[TO BE ADDED.]

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Figure 1 – Trends in BMI, Obesity, and Severe Obesity

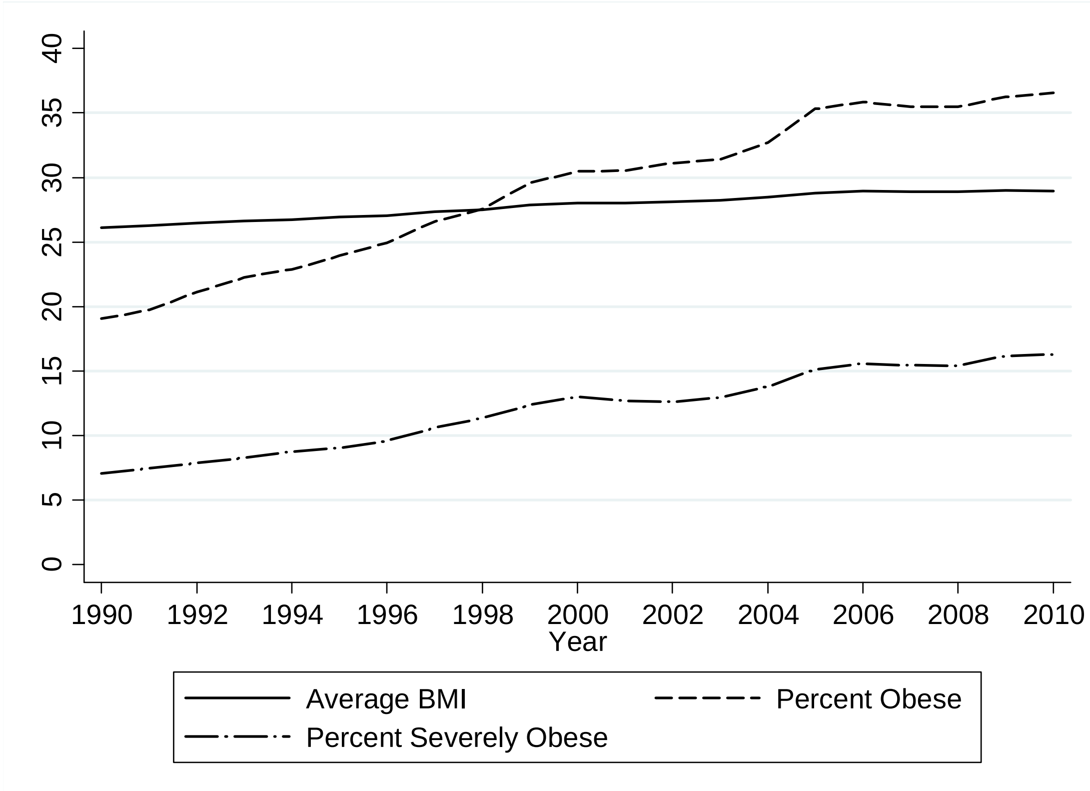

Figure 2 – Trends in Economic Factors Measured as Proportions

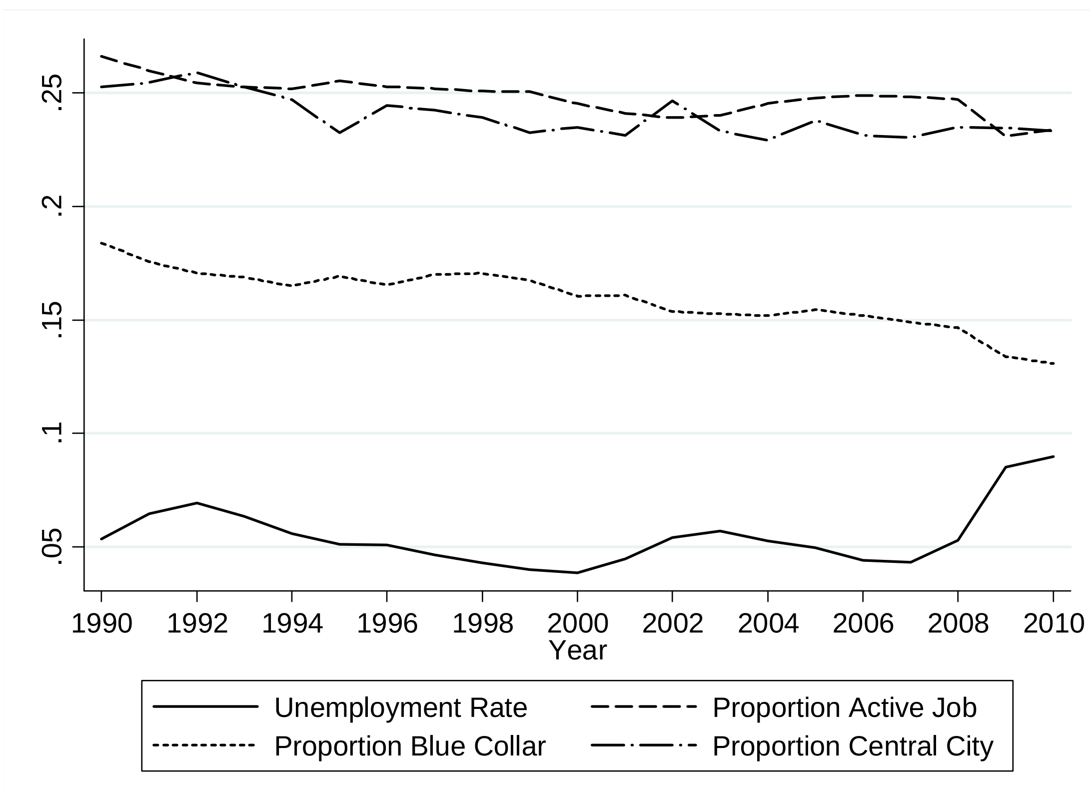

Figure 3 – Trends in Labor Force Participation Rates

Figure 4 – Trends in Income Inequality Ratios

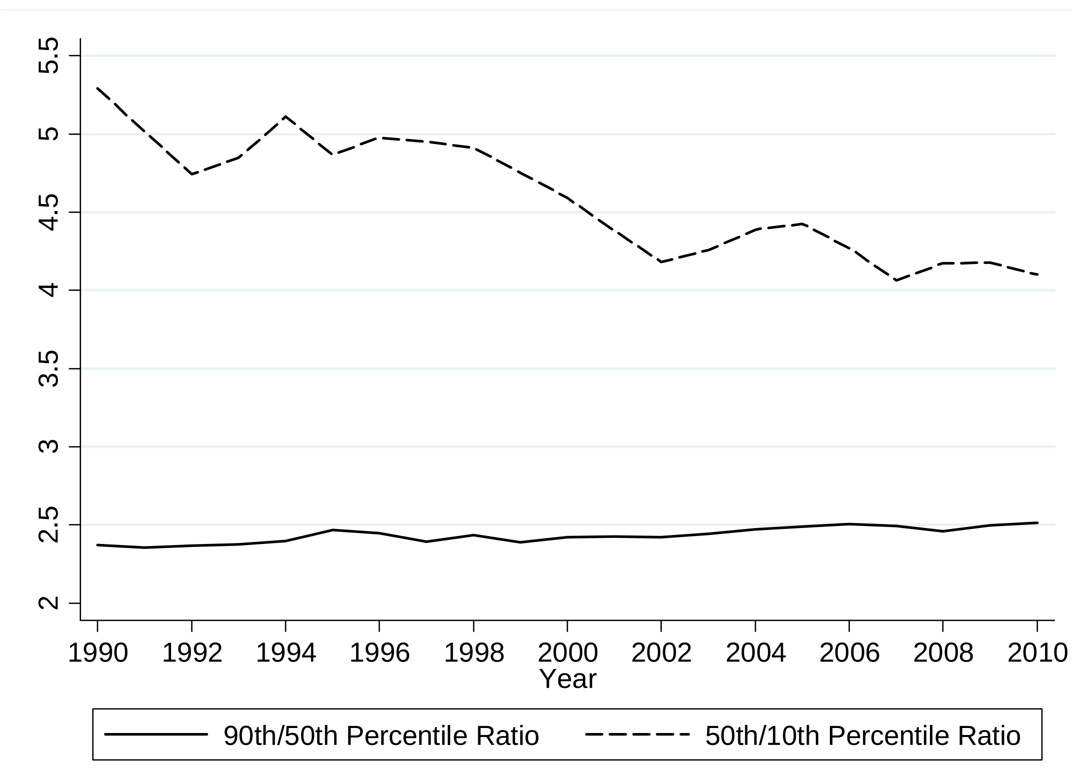

Figure 5 – Trend in Work Hours

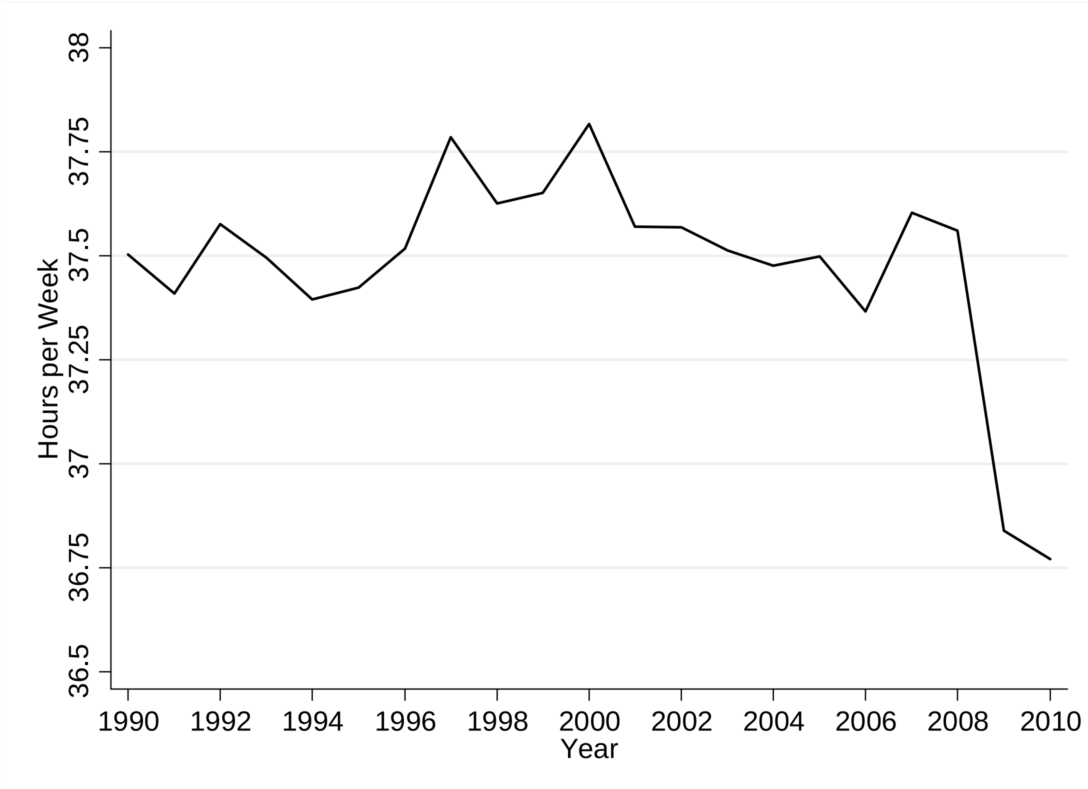

Figure 6 – Trends in Price Variables

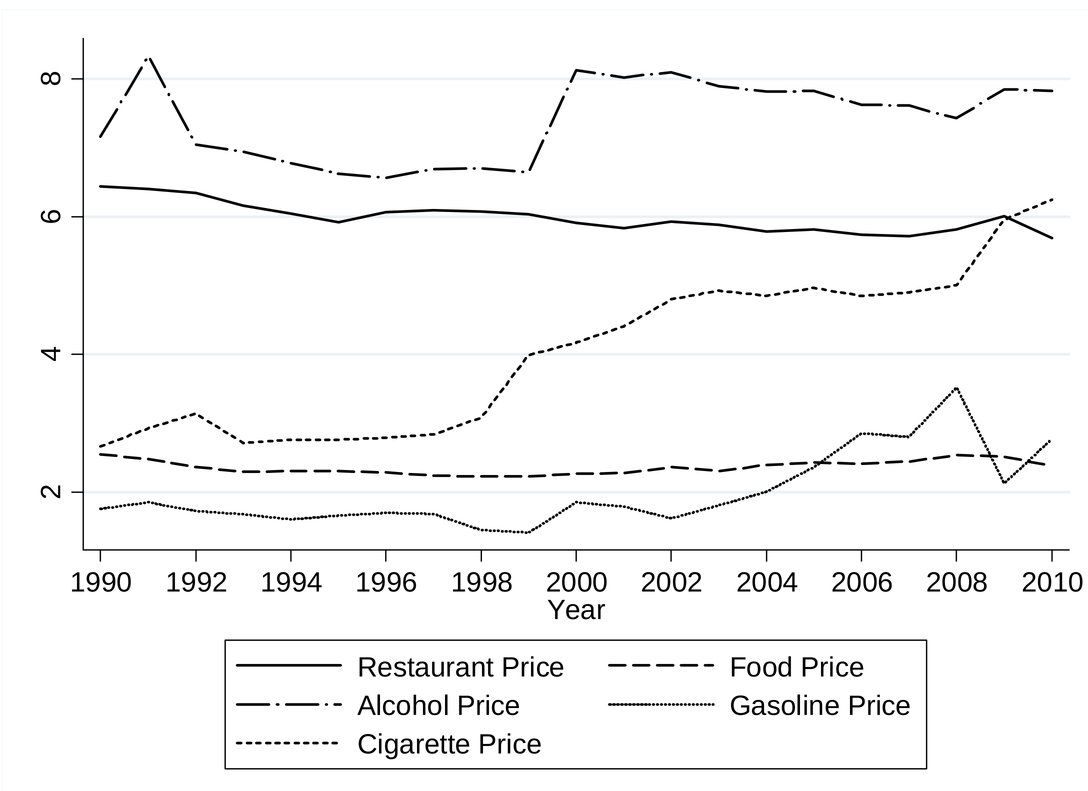

Figure 7 – Trend in Relative Price of Fruits and Vegatables

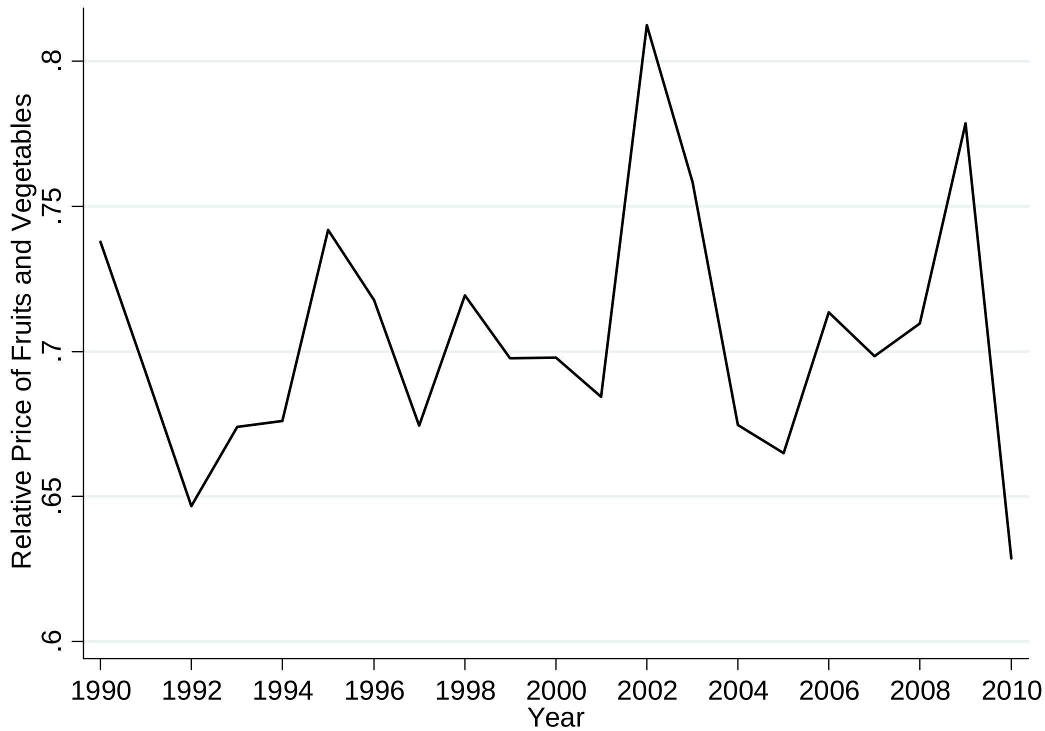

Figure 8 – Trends in Store Variables

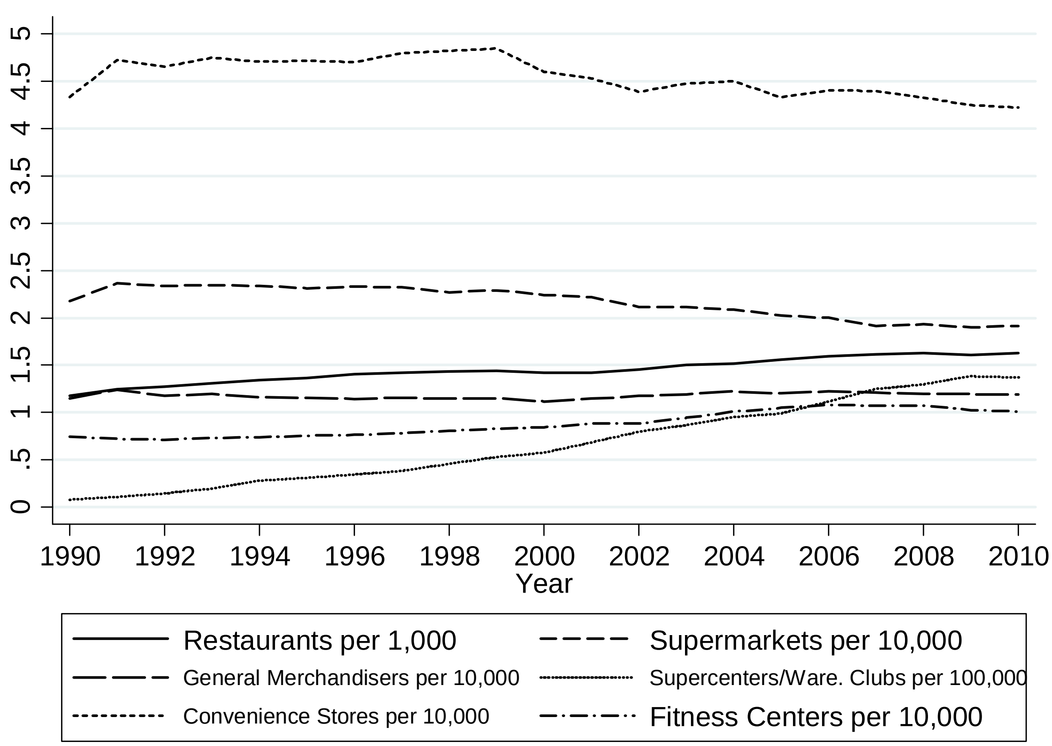

Figure 9 – Trend in Food Stamp Spending

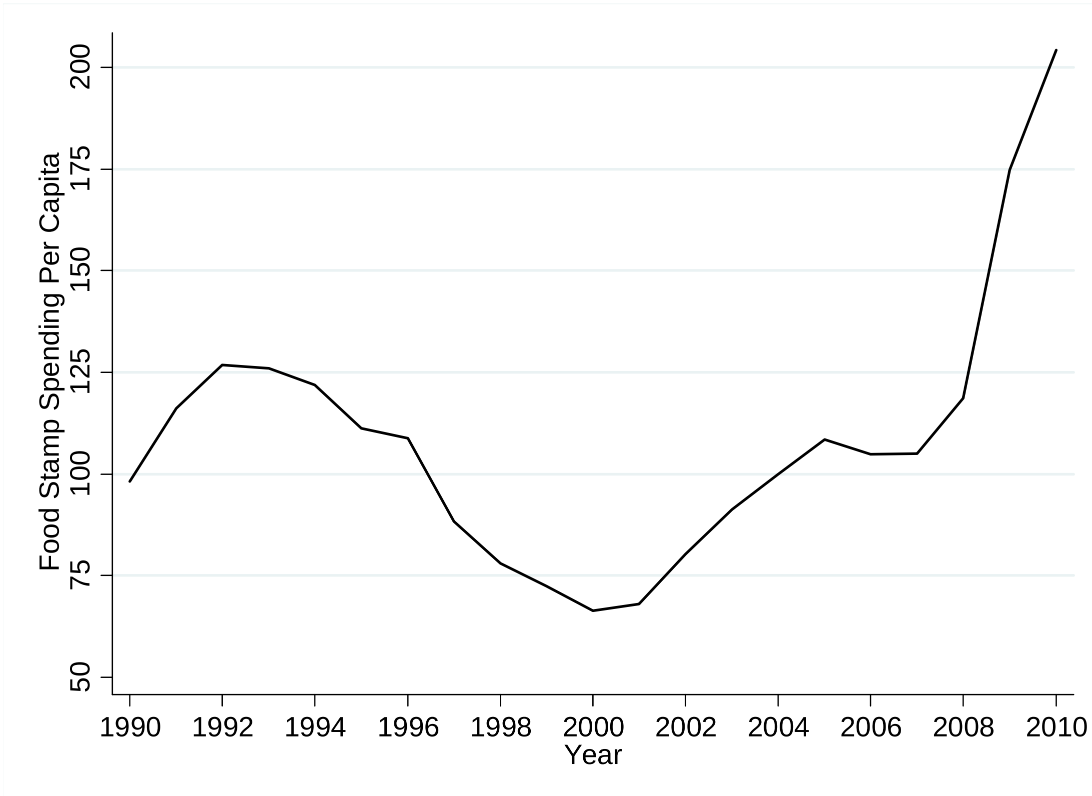

Figure 10 – Trends in Smoking Ban Variables

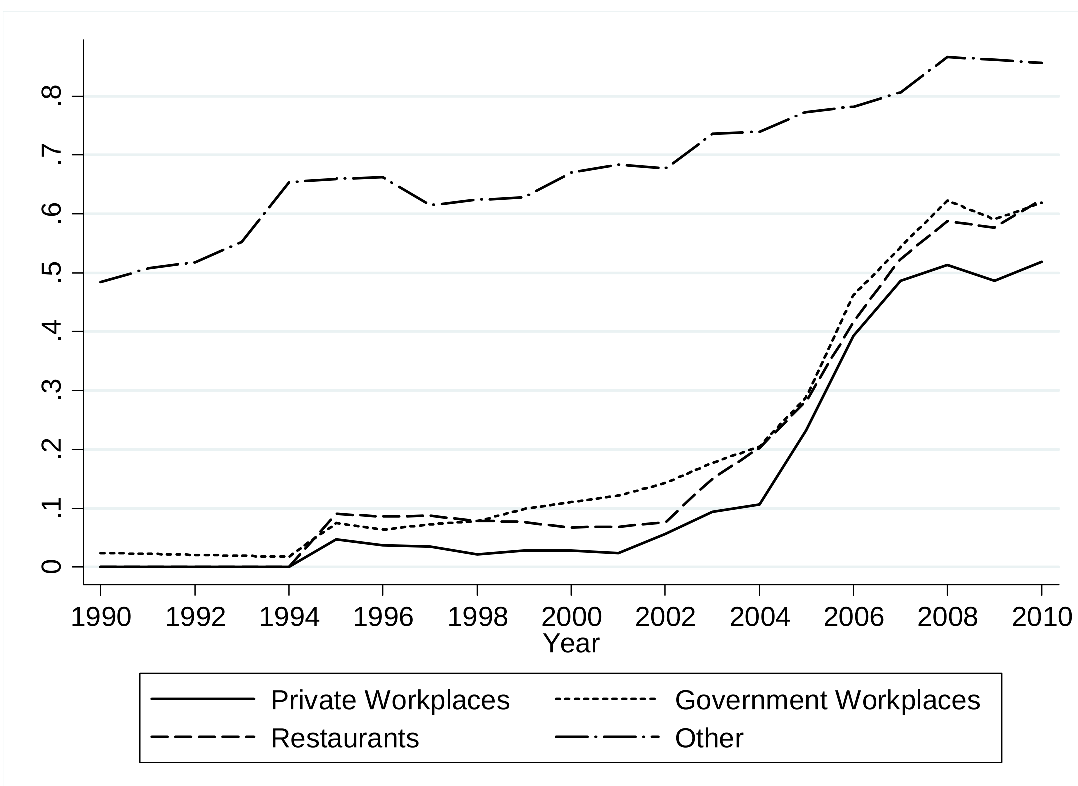

Table 1 – Percentage of Rise in BMI Explained by Prior Studies

Variable	Study	Data	Years	Percentage of Rise in BMI Explained
Fast-food price	Chou et al. (2004)	BRFSS	1984-1999	3.6%[+]
Grocery food price	Lakdawalla and Philipson (2002)	NHIS	1976-1994	40.0%
Alcohol price	Chou et al. (2004)	BRFSS	1984-1999	0.7%[+]
Restaurants	Chou et al. (2004)	BRFSS	1984-1999	64.4%[+]
Walmart Supercenters	Courtemanche and Carden (2011)	BRFSS	1994-2005	10.5%
Food stamps	Baum (2011)	NLSY	1985-2000	0.6%[+]
Work hours	Courtemanche (2009b)	NLSY	1985-2004	1.4%
Urban sprawl	Zhou and Kaestner (2010)	NHIS	1976-2001	8.6%[+]
On-the-job exercise	Lakdawalla and Philipson (2002)	NHIS	1976-1994	9.8%[+]
Gasoline prices	Courtemanche (2009b)	BRFSS	1984-2004	8.0%
Cigarette price	Chou et al. (2004)	BRFSS	1984-1999	24.9%[+]
Clean indoor air laws	Chou et al. (2004)	BRFSS	1984-1999	4.2%[+]
			Total	**176.7%**

Notes: BRFSS is Behavioral Risk Factor Surveillance System, NHIS is National Health Interview Survey, and NLSY is National Longitudinal Survey of Youth. [+] denotes estimate is our calculation based on summary statistics and coefficient estimates from the paper, as opposed to being directly presented by the paper's authors.

Table 2 – Weight, Control, and Falsification Test Variables

Variable	Source	Description	Mean (Standard Deviation)	1990 Mean	2010 Mean
BMI	BRFSS	Body mass index	26.618 (6.141)	26.027	28.507
Obese	BRFSS	Dummy for BMI≥30	0.279 (0.449)	0.184	0.339
Severely obese	BRFSS	Dummy for BMI≥35	0.111 (0.314)	0.066	0.141
Black	BRFSS	Dummy for race/ethnicity is non-Hispanic black	0.100 (0.300)	0.100	0.104
Hispanic	BRFSS	Dummy for race/ethnicity is Hispanic	0.120 (0.325)	0.083	0.142
Other	BRFSS	Dummy for race/ethnicity is not white, black, or Hispanic	0.056 (0.229)	0.030	0.076
Male	BRFSS	Dummy for sex is male	0.519 (0.500)	0.509	0.520
Some high school	BRFSS	Dummy for some high school but no degree	0.071 (0.257)	0.093	0.058
High school graduate	BRFSS	Dummy for high school degree but no college	0.301 (0.459)	0.347	0.260
Some college	BRFSS	Dummy for some college but no four-year degree	0.282 (0.450)	0.275	0.268
College graduate	BRFSS	Dummy for college graduate or further	0.315 (0.464)	0.250	0.387
Married	BRFSS	Dummy for married	0.611 (0.487)	0.618	0.639
Divorced	BRFSS	Dummy for divorced	0.122 (0.328)	0.111	0.112
Widowed	BRFSS	Dummy for widowed	0.019 (0.138)	0.022	0.017
Age	BRFSS	Age in years	39.634 (12.506)	37.623	41.983
Population	Census	State population (in 10,000s)	12.694 (10.117)	11.557	13.941
Seatbelt	BRFSS	Dummy for always wears seatbelt[a]	0.746 (0.435)	0.581	0.861
Checkup	BRFSS	Dummy for preventive doctor checkup in past year[b]	0.675 (0.469)	0.671	0.648
Flu shot	BRFSS	Dummy for got a flu shot within past year[c]	0.300 (0.458)	0.138	0.347
Mammogram	BRFSS	Dummy for mammogram in past two years (women only)	0.509 (0.500)	0.365	0.432
Prostate	BRFSS	Dummy for digital rectal exam in past two years (men 40+)[d]	0.432 (0.495)	0.469	0.376

Notes: n=2,922,071 in all years, 55,922 in 1990, and 239,215 in 2010. BRFSS sampling weights are used. [a] indicates variable not available in 1999-2001, 2003-2005, 2007, and 2009; [b] not available 2003-2004, [c] not available 1990-1992, [d] not available 1990-2000. If variables are not available in 1990 their values in the first year they are available are reported in the "1990 mean" column.

Table 3 – State-Level General Economic Indicators

Variable	Source	Description	Mean (Standard Deviation)	1990 Mean	2010 Mean
Unemployment rate		[TABLE TO BE FILLED IN]	0.059 (0.019)	0.056	0.097
Median household income			5.087 (0.678)	4.836	4.986
90/50 ratio			2.479 (0.166)	2.375	2.579
50/10 ratio			4.398 (0.699)	5.137	4.005

Notes: n=2,922,071 in all years, 55,922 in 1990, and 239,215 in 2010. BRFSS sampling weights are used.

Table 4 – State-Level Labor Supply Variables

Variable	Source	Description	Mean (Standard Deviation)	1990 Mean	2010 Mean
Female labor force p. rate		[TABLE TO BE FILLED IN]	0.582 (0.038)	0.564	0.579
Male labor force p. rate			0.718 (0.033)	0.735	0.694
Average work hours			37.564 (0.834)	37.660	36.791
Proportion active job			0.243 (0.028)	0.256	0.233
Proportion blue collar			0.159 (0.032)	0.184	0.130

Notes: n=2,922,071 in all years, 55,922 in 1990, and 239,215 in 2010. BRFSS sampling weights are used.

Table 5 – State-Level Variables Related to Monetary or Time Costs of Calorie Intake

Variable	Source	Description	Mean (Standard Deviation)	1990 Mean	2010 Mean
Fast-food restaurant price	C2ER	Weighted average price of McDonald's Quarter-Pounder with cheese, 11"-12" Pizza Hut or Pizza Inn thin crust cheese pizza, and Kentucky Fried Chicken or Church's thigh and drumstick	5.967 (0.406)	6.502	5.681
Grocery food price	C2ER	Weighted average price of white bread, Kellog's or Post corn flakes, iceberg lettuce, bananas, potatoes, Del Monte or Green Giant canned peas, Hunts, Del Monte, or Libby's canned peaches, frozen corn, t-bone steak, ground beef, whole chicken, Jimmy Dean or Owen sausage, grade A or AA eggs, Starkist or Chicken of the Sea light tuna, Coca Cola, whole milk, cane or beat sugar, Crisco shortening, Kraft parmesan cheese, and Blue Bonnet or Parkay margarine	2.398 (0.237)	2.547	2.383
Relative price of fruits and vegetables	C2ER	Ratio of weighted average prices of the above fruit and vegetable items to the other grocery food items	0.697 (0.071)	0.727	0.632
Alcohol price	C2ER	Weighted average price of Heineken 6-pack and Chablis or Chenin Blanc white	7.401 (0.825)	7.023	7.784
Restaurants	QCEW	Restaurants per 10,000 residents	13.851 (2.172)	10.813	15.551
Supercenters/ warehouse clubs	Primary	Walmart Supercenters, Sam's Clubs, Costcos, and BJ's Wholesale Clubs per 10,000 residents	0.065 (0.051)	0.009	0.127
Supermarkets	QCEW	Supermarkets/grocery stores per 10,000 residents	2.098 (0.656)	1.928	1.950
Convenience stores	QCEW	Convenience stores per 10,000 residents	4.029 (1.325)	3.705	3.768
General merchandisers	QCEW	General merchandise stores (minus supercenters/warehouse clubs) per 10,000 residents	1.056 (0.404)	0.946	1.135
Food stamp benefits		Per capita food stamp benefits (2010$)	112.01 (48.751)	99.162	208.437

Notes: n=2,922,071 in all years, 55,922 in 1990, and 239,215 in 2010. BRFSS sampling weights are used.

Table 6 – State-Level Variables Related to Monetary or Time Costs of Physical Activity

Variable	Source	Description	Mean (Standard Deviation)	1990 Mean	2010 Mean
Gasoline price	C2ER	Price of one gallon of regular unleaded gasoline (including taxes) (2010$)	2.056 (0.587)	1.723	2.796
Fitness centers	QCEW	Fitness centers/sports clubs per 10,000 residents	0.838 (0.215)	0.706	0.941
Proportion central city	Census	Proportion of residents in central city of an MSA	0.254 (0.106)	0.273	0.246

Notes: n=2,922,071 in all years, 55,922 in 1990, and 239,215 in 2010. BRFSS sampling weights are used.

Table 7 – State-Level Variables Related to Monetary or Time Costs of Smoking

Variable	Source	Description	Mean (Standard Deviation)	1990 Mean	2010 Mean
Cigarette price	*Tax Burden on Tobacco*	Weighted average price of pack of cigarettes (2010$)	4.159 (1.318)	2.756	6.265
Smoking ban: private	ImpacTeen	Dummy for state law prohibiting smoking in private workplaces	0.143 (0.351)	0	0.471
Smoking ban: government	ImpacTeen	Dummy for state law prohibiting smoking in government workplaces	0.170 (0.376)	0.007	0.521
Smoking ban: restaurant	ImpacTeen	Dummy for state law prohibiting smoking in restaurants	0.243 (0.429)	0	0.621
Smoking ban: other	ImpacTeen	Dummy for other state smoking bans	0.717 (0.450)	0.547	0.851

Notes: n=2,922,071 in all years, 55,922 in 1990, and 239,215 in 2010. BRFSS sampling weights are used.

Table 8 – Impacts of One Standard Deviation Increases in Economic Factors on BMI

	Separate Regressions	Surviving Factors Only	All Factors Together	Add Lags (Surviving Only)
General Economic Indicators				
Unemployment rate	0.032 (0.031)	--	0.007 (0.017)	--
Median household income	-0.013 (0.029)	0.041 (0.024)*	0.057 (0.023)**	0.046 (0.023)*^{0}
90/50 ratio	-0.052 (0.014)***	--	-0.015 (0.009)	--
50/10 ratio	-0.029 (0.016)*	--	-0.013 (0.011)	-0.020 (0.019)^{1}
Labor Supply Variables				
Female labor force p. rate	-0.035 (0.027)	--	-0.031 (0.019)	--
Male labor force p. rate	-0.021 (0.022)	--	0.006 (0.018)	--
Average work hours	0.008 (0.015)	--	-0.004 (0.012)	--
Proportion active job	-0.037 (0.025)	--	0.015 (0.016)	--
Proportion blue collar	-0.050 (0.035)	-0.035 (0.020)*	-0.047 (0.021)**	-0.027 (0.022)^{0}
Variables Related to Monetary or Time Costs of Calorie Intake				
Fast-food restaurant price	-0.012 (0.029)	--	-0.029 (0.024)	--
Grocery food price	-0.111 (0.030)***	--	-0.002 (0.028)	-0.053 (0.035)^{3}
Rel. price of fruits/vege.	-0.014 (0.026)	--	-0.002 (0.012)	--
Alcohol price	0.021 (0.027)	0.028 (0.015)*	0.031 (0.016)*	0.015 (0.017)^{0}
Restaurants	0.039 (0.065)	0.144 (0.035)***	0.139 (0.039)***	0.127 (0.042)***^{0}
Supercenters/ware. clubs	0.241 (0.027)***	0.194 (0.023)***	0.187 (0.034)***	0.131 (0.025)***^{0}
Supermarkets	-0.160 (0.052)***	-0.079 (0.035)**	-0.089 (0.032)***	-0.065 (0.042)^{0}
Convenience stores	-0.062 (0.076)	-0.045 (0.050)	-0.060 (0.049)	-0.094 (0.066)^{0}
General merchandisers	0.173 (0.046)***	--	0.049 (0.038)	--
Food stamp benefits	0.064 (0.039)	0.040 (0.020)*	0.030 (0.023)	0.045 (0.023)*^{0}
Variables Related to Monetary or Time Costs of Physical Activity				
Gasoline price	-0.232 (0.102)**	-0.071 (0.056)	-0.044 (0.062)	-0.075 (0.072)^{0}
Fitness centers	-0.197 (0.036)***	-0.094 (0.025)***	-0.094 (0.029)***	-0.115 (0.036)***^{3}
Proportion central city	-0.211 (0.156)	-0.110 (0.090)	-0.069 (0.079)	-0.081 (0.099)^{0}
Variables Related to Monetary or Time Costs of Smoking				
Cigarette price	-0.108 (0.049)**	--	0.036 (0.031)	--
Smoking ban: private	-0.017 (0.022)	--	0.023 (0.023)	--
Smoking ban: government	-0.009 (0.023)	--	-0.011 (0.020)	--
Smoking ban: restaurant	-0.049 (0.025)*	--	-0.010 (0.015)	--
Smoking ban: other	0.058 (0.024)**	--	0.005 (0.014)	--

Notes: Standard errors, heteroskedasticity-robust and clustered by state, are in parentheses. *** statistically significant at 1% level; ** 5% level; * 10% level. All regressions include the control variables and state and year fixed effects. BRFSS sampling weights are used. N=2,922,071, except in the lags regression where the first three years are dropped and N=2,734,701. In the regression with lags, ^{0} indicates no lags were added, while ^{1},^{2}, and ^{3} indicate one, two, and three lags were added, respectively.

Table 9 – Impacts of One Standard Deviation Increases in Economic Factors on P(Obese)

	Separate Regressions	Surviving Factors Only	All Factors Together	Add Lags (Surviving Only)
General Economic Indicators				
Unemployment rate	0.002 (0.002)	--	-0.001 (0.001)	--
Median household income	-0.001 (0.002)	--	0.003 (0.002)	--
90/50 ratio	-0.003 (0.001)***	--	-0.0004 (0.0007)	--
50/10 ratio	-0.003 (0.001)***	-0.002 (0.001)**	-0.002 (0.001)**	-0.003 (0.001)**[1]
Labor Supply Variables				
Female labor force p. rate	-0.002 (0.002)	--	-0.002 (0.001)	--
Male labor force p. rate	-0.001 (0.002)	--	0.001 (0.002)	--
Average work hours	0.0003 (0.001)	--	-0.001 (0.001)	--
Proportion active job	-0.004 (0.002)*	--	-0.001 (0.001)	-0.004 (0.002)*[3]
Proportion blue collar	-0.002 (0.002)	--	-0.001 (0.001)	--
Variables Related to Monetary or Time Costs of Calorie Intake				
Fast-food restaurant price	-0.001 (0.002)	--	-0.003 (0.002)	--
Grocery food price	-0.006 (0.002)***	--	0.001 (0.002)	--
Rel. price of fruits/vege.	-0.001 (0.001)	--	-0.0001 (0.001)	--
Alcohol price	0.001 (0.002)	--	0.001 (0.001)	--
Restaurants	0.004 (0.004)	0.007 (0.003)**	0.010 (0.003)***	0.008 (0.003)**[0]
Supercenters/ware. clubs	0.015 (0.002)***	0.012 (0.002)***	0.011 (0.002)***	0.011 (0.002)***[0]
Supermarkets	-0.008 (0.003)**	-0.008 (0.003)**	-0.005 (0.003)*	-0.008 (0.003)**[0]
Convenience stores	-0.003 (0.004)	--	-0.005 (0.003)	--
General merchandisers	0.012 (0.003)***	0.006 (0.003)**	0.006 (0.003)**	0.006 (0.003)**[0]
Food stamp benefits	0.004 (0.002)*	--	0.003 (0.002)	--
Variables Related to Monetary or Time Costs of Physical Activity				
Gasoline price	-0.012 (0.006)**	--	-0.001 (0.005)	--
Fitness centers	-0.010 (0.003)***	--	-0.004 (0.003)	--
Proportion central city	-0.014 (0.009)	--	-0.004 (0.005)	--
Variables Related to Monetary or Time Costs of Smoking				
Cigarette price	-0.007 (0.003)*	--	0.003 (0.003)	--
Smoking ban: private	-0.001 (0.001)	--	0.001 (0.001)	--
Smoking ban: government	-0.001 (0.001)	--	-0.001 (0.001)	--
Smoking ban: restaurant	-0.003 (0.002)**	--	-0.001 (0.001)	--
Smoking ban: other	0.005 (0.002)**	--	0.002 (0.001)*	--

Notes: Standard errors, heteroskedasticity-robust and clustered by state, are in parentheses. *** statistically significant at 1% level; ** 5% level; * 10% level. All regressions include the control variables and state and year fixed effects. BRFSS sampling weights are used N=2,922,071, except in the lags regression where the first three years are dropped and N=2,734,701. In the regression with lags, [0] indicates no lags were added, while [1],[2], and [3] indicate one, two, and three lags were added, respectively.

Table 10 – Impacts of One Std. Dev. Increases in Economic Factors on P(Severely Obese)

	Separate Regressions	Surviving Factors Only	All Factors Together	Add Lags (Surviving Only)
General Economic Indicators				
Unemployment rate	0.002 (0.001)	--	-0.001 (0.001)	
Median household income	-0.002 (0.002)	--	0.001 (0.001)	
90/50 ratio	-0.002 (0.001)***	--	-0.0003 (0.0005)	
50/10 ratio	-0.001 (0.001)	--	-0.0004 (0.0005)	-0.002 (0.001)**[2]
Labor Supply Variables				
Female labor force p. rate	-0.001 (0.001)	--	0.001 (0.001)	
Male labor force p. rate	-0.002 (0.001)*	--	-0.001 (0.001)	
Average work hours	0.0003 (0.0006)	--	-0.0001 (0.001)	
Proportion active job	-0.002 (0.001)	--	0.001 (0.001)	
Proportion blue collar	-0.003 (0.002)**	-0.002 (0.001)***	-0.003 (0.001)***	-0.004 (0.001)***[2]
Variables Related to Monetary or Time Costs of Calorie Intake				
Fast-food restaurant price	-0.0004 (0.001)	--	-0.001 (0.001)	
Grocery food price	-0.005 (0.001)***	--	-0.0004 (0.001)	-0.003 (0.002)*[3]
Rel. price of fruits/vege.	-0.001 (0.001)	--	-0.0003 (0.0006)	
Alcohol price	-0.0001 (0.001)	--	0.0003 (0.0008)	
Restaurants	0.004 (0.003)	0.006 (0.002)***	0.008 (0.002)***	0.006 (0.002)***[0]
Supercenters/ware. clubs	0.011 (0.001)***	0.009 (0.001)***	0.008 (0.002)***	0.006 (0.001)***[0]
Supermarkets	-0.007 (0.002)***	-0.006 (0.002)***	-0.005 (0.001)***	-0.006 (0.002)**[0]
Convenience stores	-0.001 (0.003)	--	-0.003 (0.002)	
General merchandisers	0.009 (0.002)***	0.003 (0.002)*	0.003 (0.001)*	-0.001 (0.002)[0]
Food stamp benefits	0.004 (0.002)**	0.002 (0.001)**	0.003 (0.001)**	0.002 (0.001)*[0]
Variables Related to Monetary or Time Costs of Physical Activity				
Gasoline price	-0.009 (0.005)**	--	-0.001 (0.003)	--
Fitness centers	-0.008 (0.002)***	--	-0.003 (0.001)	-0.003 (0.002)[2]
Proportion central city	-0.010 (0.006)*	-0.004 (0.003)	-0.004 (0.003)	-0.005 (0.004)[0]
Variables Related to Monetary or Time Costs of Smoking				
Cigarette price	-0.006 (0.002)***	--	0.0002 (0.001)	--
Smoking ban: private	-0.002 (0.001)	--	0.001 (0.001)	--
Smoking ban: government	-0.001 (0.001)	--	-0.001 (0.001)	--
Smoking ban: restaurant	-0.003 (0.001)**	--	-0.001 (0.001)	--
Smoking ban: other	0.003 (0.001)**	--	0.001 (0.001)	--

Notes: Standard errors, heteroskedasticity-robust and clustered by state, are in parentheses. *** statistically significant at 1% level; ** 5% level; * 10% level. All regressions include the control variables and state and year fixed effects. BRFSS sampling weights are used. N=2,922,071, except in the lags regression where the first three years are dropped and N=2,734,701. In the regression with lags, [0] indicates no lags were added, while [1],[2], and [3] indicate one, two, and three lags were added, respectively.

Table 11 – Percentage of Rise in BMI Explained by Changes in Economic Factors

	Separate Regressions	Surviving Factors Only	All Factors Together	Add Lags (Surviving Only)
General Economic Indicators				
Unemployment rate	2.8% (2.7%)	--	2.2% (1.6%)	--
Median household income	-0.1% (0.3%)	0.4% (0.2%)*	0.4% (0.2%)*	1.2% (0.6%)*
90/50 ratio	-2.6% (0.7%)***	--	-0.7% (0.5%)	--
50/10 ratio	1.9% (1.1%)*	--	0.7% (0.7%)	0.9% (0.9%)
Subtotal	**2.5%**$^{+}$	**0.4% (0.2%)***	**1.3% (1.7%)**	**2.1% (1.1%)***
Labor Supply Variables				
Female labor force p. rate	-0.5% (0.4%)	--	-0.5% (0.3%)*	--
Male labor force p. rate	1.0% (1.1%)	--	-0.2% (0.9%)	--
Average work hours	-0.3% (0.6%)	--	0.2% (0.5%)	--
Proportion active job	1.3% (0.9%)	--	-0.5% (0.5%)	--
Proportion blue collar	3.5% (2.4%)	2.4% (1.4%)*	3.3% (1.5%)**	1.8% (1.4%)
Subtotal	**5.0%**$^{+}$	**2.4% (1.4%)***	**2.1% (1.8%)**	**1.8% (1.4%)**
Variables Related to Monetary or Time Costs of Calorie Intake				
Fast-food restaurant price	1.0% (2.4%)	--	2.4% (2.0%)	--
Grocery food price	3.1% (0.8%)***	--	0.04% (0.8%)	0.4% (0.9%)
Rel. price of fruits/vege.	0.7% (1.4%)	--	0.2% (0.6%)	--
Alcohol price	0.8% (1.0%)	1.0% (0.6%)*	0.9% (0.6%)	-0.8% (1.0%)
Restaurants	3.3% (5.7%)	12.6% (3.1%)***	11.9% (3.4%)***	14.4% (4.7%)***
Supercenters/ware. clubs	22.1% (2.5%)***	17.8% (2.1%)***	17.8% (3.2%)***	14.3% (2.7%)***
Supermarkets	-0.2% (0.1%)***	-0.08% (0.03%)**	-0.1% (0.03%)***	1.4% (0.9%)
Convenience stores	0.1% (0.2%)	-0.1% (0.1%)	-0.1% (0.1%)	2.1% (1.4%)
General merchandisers	3.2% (0.9%)***	--	0.8% (0.7%)	--
Food stamp benefits	5.8% (3.6%)	3.6% (1.8%)*	4.1% (2.1%)*	3.7% (1.9%)*
Subtotal	**39.9%**$^{+}$	**34.9% (3.9%)***	**36.5% (5.7%)***	**35.4% (6.4%)***
Variables Related to Monetary or Time Costs of Physical Activity				
Gasoline price	-17.1% (7.5%)**	-5.2% (4.1%)	-3.6% (4.5%)	-7.4% (7.1%)
Fitness centers	-8.7% (1.6%)***	-4.1% (1.1%)***	-4.2% (1.3%)***	-7.8% (2.3%)***
Proportion central city	2.2% (1.6%)	1.1% (0.9%)	0.7% (0.8%)	0.8% (1.0%)
Subtotal	**-23.6%**$^{+}$	**-8.3% (4.3%)***	**-6.7% (4.5%)**	**-14.5% (7.2%)****
Variables Related to Monetary or Time Costs of Smoking				
Cigarette price	-11.6% (5.2%)**	--	4.2% (3.5%)	--
Smoking ban: private	-0.9% (1.2%)	--	1.0% (1.2%)	--
Smoking ban: government	-0.5% (1.3%)	--	-0.3% (1.0%)	--
Smoking ban: restaurant	-2.9% (1.5%)*	--	-0.6% (0.8%)	--
Smoking ban: other	1.6% (0.6%)**	--	0.1% (0.4%)	--
Subtotal	**-14.3%**$^{+}$	**0%**	**4.0% (3.4%)**	**0%**
Total from Econ. Factors	**9.5%**$^{+}$	**27.0% (7.2%)***	**33.2% (9.5%)***	**24.8% (12.2%)**
Total from Controls	**--**$^{++}$	**10.5% (1.1%)***	**10.4% (1.1%)**$^{++}$	**10.2% (1.5%)***

Notes: *** indicates statistically significant at the 1% level; ** 5% level; * 10% level. $^{+}$ indicates this is the sum of estimates from separate regressions, so we do not calculate standard errors or levels of statistical significance. $^{++}$ indicates we do not report the total from controls since it varies for each of the many regressions in the column.

Table 12 – Percentage of Rise in Obesity Explained by Changes in Economic Factors

	Separate Regressions	Surviving Factors Only	All Factors Together	Add Lags (Surviving Only)
General Economic Indicators				
Unemployment rate	2.2% (2.9%)	--	-1.1% (1.9%)	--
Median household income	-0.1% (0.3%)	--	0.4% (0.3%)	--
90/50 ratio	-2.4% (0.7%)***	--	-0.3% (0.6%)	--
50/10 ratio	3.3% (1.2%)***	2.1% (0.9%)**	2.1% (0.9%)**	2.7% (1.1%)**
Subtotal	**3.2%⁺**	**2.1% (0.9%)****	**1.1% (2.1%)**	**2.7% (1.1%)****
Labor Supply Variables				
Female labor force p. rate	-0.4% (0.4%)	--	-0.4% (0.3%)	--
Male labor force p. rate	0.5% (1.4%)	--	-1.0% (1.2%)	--
Average work hours	-0.2% (0.7%)	--	0.5% (0.7%)	--
Proportion active job	2.0% (1.1%)*	--	0.8% (0.7%)	1.5% (0.8%)*
Proportion blue collar	2.7% (2.1%)	--	1.0% (1.6%)	--
Subtotal	**4.6%⁺**	**0%**	**0.9% (2.0%)**	**1.5% (0.8%)***
Variables Related to Monetary or Time Costs of Calorie Intake				
Fast-food restaurant price	1.4% (2.2%)	--	3.4% (2.1%)	--
Grocery food price	2.5% (0.7%)***	--	-0.6% (0.9%)	--
Rel. price of fruits/vege.	0.6% (1.3%)	--	0.04% (0.8%)	--
Alcohol price	0.5% (1.0%)	--	0.8% (0.8%)	--
Restaurants	5.2% (5.9%)	10.5% (4.2%)**	13.8% (4.5%)***	13.3% (5.2%)**
Supercenters/ware. clubs	21.6% (2.8%)***	18.0% (2.7%)***	16.3% (3.4%)***	19.4% (3.1%)***
Supermarkets	-0.1 (0.05)**	-0.12% (0.05%)**	-0.08% (0.04%)*	2.5% (1.0%)**
Convenience stores	-0.1% (0.1%)	--	-0.2% (0.1%)	--
General merchandisers	3.7% (1.0%)***	1.7% (0.8%)**	1.7% (0.8%)**	1.1% (0.5%)**
Food stamp benefits	6.1% (3.6%)*	--	3.9% (2.9%)	--
Subtotal	**41.4%⁺**	**30.1% (4.8%)*****	**39.1% (7.1%)**	**36.3% (6.1%)*****
Variables Related to Monetary or Time Costs of Physical Activity				
Gasoline price	-14.4% (6.8%)**	--	-0.6% (5.4%)	--
Fitness centers	-6.9% (1.9%)***	--	-2.7% (2.1%)	--
Proportion central city	2.3% (1.4%)	--	0.7% (0.9%)	--
Subtotal	**-19.0%⁺**	**0%**	**-2.6% (5.8%)**	**0%**
Variables Related to Monetary or Time Costs of Smoking				
Cigarette price	-11.5% (5.8%)*	--	4.4% (4.6%)	--
Smoking ban: private	-1.0% (1.1%)	--	0.9% (1.0%)	--
Smoking ban: government	-0.5% (1.2%)	--	-0.5% (1.1%)	--
Smoking ban: restaurant	-2.9% (1.4%)**	--	-1.3% (0.9%)	--
Smoking ban: other	2.0% (0.8%)**	--	0.8% (0.5%)*	--
Subtotal	**-13.9%⁺**	**0%**	**4.3% (4.3%)**	**0%**
Total from Econ. Factors	**16.3%⁺**	**32.2% (4.8%)*****	**38.5% (12%)*****	**40.5% (6.1%)*****
Total from Controls	**--⁺⁺**	**6.4% (1.1%)*****	**6.1% (1.3)*****	**9.1% (1.4%)*****

Notes: *** indicates statistically significant at the 1% level; ** 5% level; * 10% level. ⁺ indicates this is the sum of estimates from separate regressions, so we do not calculate standard errors or levels of statistical significance. ⁺⁺ indicates we do not report the total from controls since it varies for each of the many regressions in the column.

Table 13 – Percentage of Rise in Severe Obesity Explained by Changes in Economic Factors

	Separate Regressions	Surviving Factors Only	All Factors Together	Add Lags (Surviving Only)
General Economic Indicators				
Unemployment rate	5.0% (4.0%)	--	-2.6% (2.7%)	--
Median household income	-0.7% (0.4%)	--	0.3% (0.4%)	--
90/50 ratio	-3.7% (1.1)***	--	-0.4% (0.8%)	--
50/10 ratio	1.9% (1.4%)	--	0.8% (1.1%)	3.9% (1.8%)**
Subtotal	**2.5%+**	**0%**	**-1.9% (2.8%)**	**3.9% (1.8%)**
Labor Supply Variables				
Female labor force p. rate	-0.4% (0.7%)	--	0.3% (0.4%)	--
Male labor force p. rate	3.7% (1.9%)*	--	2.1% (1.5%)	--
Average work hours	-0.4% (0.9%)	--	0.2% (0.7%)	--
Proportion active job	2.2% (1.4%)	--	-1.1% (0.9%)	--
Proportion blue collar	7.5% (3.5%)**	5.5% (1.9%)***	6.2% (2.2%)***	7.9% (2.5%)***
Subtotal	**12.6%+**	**5.5% (1.9%)**	**7.8% (2.1%)*** **	**7.9% (2.5%)*** **
Variables Related to Monetary or Time Costs of Calorie Intake				
Fast-food restaurant price	1.2% (3.0%)	--	1.6% (2.2%)	
Grocery food price	4.9% (1.2%)***	--	0.3% (1.1%)	-0.5% (1.0%)
Rel. price of fruits/vege.	1.4% (2.2%)	--	0.6% (1.0%)	
Alcohol price	-0.2% (1.7%)	--	0.3% (0.9%)	
Restaurants	10.5% (8.4%)	18.5% (4.9%)***	22.9% (6.2%)***	20.5% (6.2%)***
Supercenters/ware. clubs	33.1% (4.1%)***	27.5% (3.5%)***	24.1% (4.7%)	22.0% (5.1%)***
Supermarkets	-0.2% (0.1%)***	-0.2% (0.1%)***	-0.1% (0.04%)***	3.7% (1.5%)**
Convenience stores	-0.1% (0.2%)	--	-0.2% (0.2%)	
General merchandisers	5.6% (1.2%)***	1.8% (0.9%)*	1.8% (0.9%)*	-0.4% (0.7%)
Food stamp benefits	13.2% (5.6%)**	7.2% (3.4%)**	8.3% (3.6%)**	5.3% (3.1%)*
Subtotal	**69.4%+**	**54.8% (6.6%)*** **	**59.6% (9.7%)*** **	**50.6% (8.8%)*** **
Variables Related to Monetary or Time Costs of Physical Activity				
Gasoline price	-22.7% (11.0%)**	--	-2.8% (7.6%)	
Fitness centers	-11.7% (2.7%)***	--	-3.6% (2.1%)*	-6.7% (4.1%)
Proportion central city	3.4% (2.0%)*	1.4% (0.9%)	1.2% (0.9%)	1.6% (1.2%)
Subtotal	**-31.0%+**	**1.4% (0.9%)**	**-5.2% (7.8%)**	**-5.1% (4.3%)**
Variables Related to Monetary or Time Costs of Smoking				
Cigarette price	-19.6% (7.3%)***	--	0.6% (3.8%)	--
Smoking ban: private	-2.8% (1.9%)	--	1.8% (1.8%)	--
Smoking ban: government	-2.3% (2.0%)	--	-1.9% (1.7%)	--
Smoking ban: restaurant	-5.9% (2.6%)**	--	-2.2% (1.0%)**	--
Smoking ban: other	2.6% (1.2%)**	--	0.7% (0.9%)	--
Subtotal	**-28.0%+**	**0%**	**-1.0% (4.2%)**	**0%**
Total from Econ. Factors	**25.5%+**	**61.7% (7.2%)*** **	**60.3% (15%)*** **	**57.2% (11%)*** **
Total from Controls	**--++**	**3.3% (1.8%)***	**2.7% (1.8%)**	**1.2% (2.5%)**

Notes: *** indicates statistically significant at the 1% level; ** 5% level; * 10% level. + indicates this is the sum of estimates from separate regressions, so we do not calculate standard errors or levels of statistical significance. ++ indicates we do not report the total from controls since it varies for each of the many regressions in the column.

Table 14 – Falsification Tests ("Impacts" of One Standard Deviation Increases in Selected Economic Factors)

	Seatbelt	Doctor	Flu Shot	Mammogram	Prostate
Proportion blue collar	0.003 (0.008)	-0.008 (0.005)	-0.001 (0.003)	-0.003 (0.003)	0.004 (0.006)
Restaurants	0.001 (0.008)	-0.016 (0.011)	0.008 (0.005)	-0.001 (0.003)	0.015 (0.008)*
Supercenters/ ware. clubs	0.010 (0.008)	-0.011 (0.007)	0.001 (0.004)	0.006 (0.003)	0.0003 (0.006)
Food stamp benefits	-0.004 (0.010)	-0.014 (0.011)	-0.001 (0.005)	-0.010 (0.006)	-0.008 (0.006)
Gasoline price	0.021 (0.014)	-0.021 (0.021)	-0.002 (0.010)	-0.002 (0.005)	0.013 (0.009)
Fitness centers	0.026 (0.010)**	0.017 (0.008)**	0.002 (0.008)	0.013 (0.005)***	-0.012 (0.008)
Number of observations	1,275,291	2,276,897	2,454,524	1,167,870	281,820

Notes: Standard errors, heteroskedasticity-robust and clustered by state, are in parentheses. *** statistically significant at 1% level; ** 5% level; * 10% level. All regressions include the control variables and state and year fixed effects. BRFSS sampling weights are used. N=2,922,071.

Appendix Table A1 – Replications of Chou et al.'s (2004) Model for BMI

	Chou et al's results (BRFSS 1984-1999)	Chou et al's model and our data (BRFSS 1990-1999)	Add year dummies
Restaurants	0.631 (0.067)***	0.469 (0.060)***	0.122 (0.047)***
Restaurants^2	-0.011 (0.002)***	-0.007 (0.002)***	-0.004 (0.001)***
Marginal effect at mean	0.339	0.291	0.002
Fast-food restaurant price	-1.216 (0.728)*	-2.854 (1.011)***	-0.928 (0.786)
Fast-food restaurant price^2	0.135 (0.119)	0.434 (0.174)***	0.142 (0.131)
Marginal effect at mean	-0.432	-0.416	-0.135
Food at home price	-6.462 (1.918)***	-6.047 (2.322)***	-0.311 (1.535)
Food at home price^2	2.244 (0.719)***	2.644 (1.049)***	0.172 (0.707)
Marginal effect at mean	-0.816	-0.729	0.034
Cigarette price	0.486 (0.355)	1.670 (0.367)***	0.591 (0.340)*
Cigarette price^2	0.009 (0.113)	-0.293 (0.114)***	-0.194 (0.101)*
Marginal effect at mean	0.509	0.865	0.056
Alcohol price	1.140 (0.884)	-1.654 (0.457)***	-0.971 (0.340)***
Alcohol price^2	-0.734 (0.380)*	0.199 (0.067)***	0.133 (0.051)***
Marginal effect at mean	-0.423	-0.401	-0.144
Smoking ban: private	0.015 (0.039)	0.124 (0.128)	0.082 (0.095)
Smoking ban: government	0.115 (0.071)	-0.099 (0.088)	-0.155 (0.055)***
Smoking ban: restaurant	-0.020 (0.056)	-0.092 (0.071)	-0.199 (0.037)***
Smoking ban: other	0.054 (0.056)	0.253 (0.060)***	0.020 (0.037)
Observations	1,111,074	912,454	912,454

Notes: Standard errors, heteroskedasticity-robust and clustered at the state*year level, are in parentheses. *** indicates statistically significant at the 1% level; ** 5% level; * 10% level. Regressions include state fixed effects and individual-level control variables for age, age squared, real income, real income squared, and dummies for male, race/ethnicity (black, white, Hispanic, or other), marital status (single, married, divorced, or widowed), and education (less than high school degree, high school degree, some college, or college degree). Chou et al. also included full-service restaurant price and its square, but the variable was only available every five years and was imputed for the other years. Perhaps for this reason, its effect was one of the weakest Chou et al. estimated. We have not been able to find an annual measure and therefore do not include full-service restaurant prices in our dataset.