ESSAYS IN THE ECONOMICS OF OBESITY

by

INAS RASHAD

A dissertation submitted to the Graduate Faculty in Economics in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

2004

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Abstract

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by

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Advisor: Professor Michael Grossman

Obesity is currently an epidemic, rapidly outpacing smoking as the leading cause of preventable deaths in the United States. The National Health and Nutrition Examination Surveys (NHANES) are the data sets that the Centers for Disease Control use in order to track changes in obesity over time. In *The Super Size of America: An Economic Estimation of Body Mass Index and Obesity in Adults*, I use individual-level NHANES data in order to assess the effect of various state-level variables on the increase in the obesity trend in adults. In *Structural Estimation of Caloric Intake, Exercise, Smoking and Obesity*, I use NHANES to estimate simultaneous equations models by taking advantage of information on caloric intake, physical activity, and smoking by individuals, and the mechanism through which economic factors influence these choice variables. In *Fast Food Advertising on Television and Its Influence on Childhood Obesity*, I estimate the effect of fast food advertising on television on obesity in children and adolescents using panel data sets, which allows for the estimation of individual fixed effects models to control for possible unobserved heterogeneity. Children of the 1979 National Longitudinal Survey of Youth and adolescents from the 1997 National Longitudinal Survey of Youth are used in this analysis. I discuss various economic forces that have contributed to the rapid increase in the obesity epidemic in the United States, and also address social and labor market consequences to this increase in obesity.

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Acknowledgments

This dissertation is dedicated to my parents and Sally, my sister,

For their endless love and support.

I am indebted to my advisor, Professor Michael Grossman, for his continuous advice and support. I am also indebted to Professor Robert Kaestner for advice, support, and comments. I thank Professors Turan Bali, Howard Chernick, John Devereux, Michael Dohan, Michael Edelstein, Linda Edwards, Zadia Feliciano, David Gabel, Timothy Goodspeed, Harvey Gram, Elizabeth Hendrey, Anne Hill, Ted Joyce, Hugo Kaufman, Sanders Korenman, David Laibman, Robert Lipsey, Salih Neftci, Joan Nix, Andrew Racine, Carl Riskin, Elizabeth Roistacher, Henry Saffer, William Tabb, and Thom Thurston for their help. I thank Rocio Abreu, John Cawley, Christine Chen, Gregory Colman, Silvie Colman, Dhaval Dave, Katwicia Desruisseaux, Nadia Doytch, Maha El Mikatti, Naomi Fisch, Ani and Wagdi Fouad, Zeynep Gozum, the Hodges, Meredith Kaminsky, Neeraj Kaushal, Mubena Khan, Andrea Lange, Sara Markowitz, Melissa Mendiola, Marinella Moscheni, Christine Nagorski, Bernard Quigley, Carolyn Raisner, the Rashads, Rania Sadek, Shirley Samaniego, Dana Siu, Jasmina Spasojevic, Guy Sugiyama, Crystal Suri, Jennifer Tennant, Li Xu, Mai Wahib, Diane Williams, Samantha Yendall, and Nabila Yusaf for support in one form or another.

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Chapter 1

Introduction

The increased prevalence of obesity in the United States stresses the pressing need for answers as to why this rapid rise has occurred. Table 1.1 shows how the percentage obese has increased by state between 1987 and 1997, using the Behavioral Risk Factor Surveillance System.[1] In *The Super Size of America: An Economic Estimation of Body Mass Index and Obesity in Adults* (Chapter 2), I use micro-level data from the First, Second, and Third National Health and Nutrition Examination Surveys to determine the effects that various state-level policies have on body mass index and obesity. These policies, which include the per capita number of restaurants, the food tax, the cigarette tax, and the unemployment rate, display many of the expected effects on obesity and explain a substantial amount of its trend. These findings control for individual-level measures of household income, years of formal schooling completed, and marital status.

In *Structural Estimation of Caloric Intake, Exercise, Smoking and Obesity* (Chapter 3), I employ the First, Second, and Third National Health and Nutrition Examination Surveys to estimate a structural model of the determinants of adult obesity. To control for the endogeneity of some explanatory variables, a set of reduced form equations for these outcomes is estimated simultaneously with the obesity equation. To identify each equation, I use a rich array of state-level characteristics as instrumental variables. Trends in these variables shed light on the sources of the rapid increase in obesity since 1980. It is important to note that in the *Super Size* essay I am focusing in

[1] The Behavioral Risk Factor Surveillance System is a data set put together by state health departments in conjunction with the Centers for Disease Control and Prevention. It is conducted annually through telephone surveys. In 1987, 34 states were represented; all 51 (including the District of Columbia) were represented in 1997.

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particular on the effect that a few specific state-level variables have on the increase in body mass index and obesity, whereas in the *Structural Estimation* essay I am interested in the effects of caloric intake and smoking on the outcome variables.

I shift my attention to obesity in children and adolescents in *Fast Food Advertising on Television and Its Influence on Childhood Obesity* (Chapter 4). Childhood obesity around the world, and particularly in the United States, is an escalating problem that is especially detrimental as its effects carry on into adulthood. Finding the causes for childhood obesity is key to its reduction. In this essay I employ two panel data sets, the National Longitudinal Survey of Youth 1997, and the Mother-Child National Longitudinal Survey of Youth 1979, to estimate the effects of fast food advertising on the likelihood of being overweight among children and adolescents.

After attempting to isolate possible *causes* for the rise in obesity over time, I address possible social and labor market consequences of being obese. Taking the National Longitudinal Survey of Youth 1979, I assess the likelihood of marriage using hazard models in *Marriage Markets and Obesity: How Likely Are Heavy People to Tie the Knot?* In addition, several studies have tested the effect of beauty, as measured by body mass index and other variables, on labor market variables. I look at this using a sample of 25- to 45-year-olds from the Third National Health and Nutrition Examination Survey in *The Direct Relationship Between Income and Beauty*. In the last chapter I discuss other causes and possible solutions to this rising epidemic.

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Table 1.1

Percentage Obese by State in 1987 and 1997, and Percent Change,
The Behavioral Risk Factor Surveillance System

Independent Variables	Obese, 1987	Obese, 1997	Percent Change
National average	10.12%	16.83%	66.35%
Alabama	10.81%	19.39%	79.42%
Alaska	n/a	21.56%	n/a
Arizona	9.21%	12.17%	32.10%
Arkansas	n/a	16.87%	n/a
California	7.87%	15.58%	98.07%
Colorado	n/a	11.75%	n/a
Connecticut	n/a	14.43%	n/a
Delaware	n/a	19.33%	n/a
District of Columbia	11.58%	14.81%	27.96%
Florida	9.48%	15.68%	65.29%
Georgia	9.66%	14.41%	49.08%
Hawaii	9.16%	13.56%	47.96%
Idaho	9.58%	16.26%	69.75%
Illinois	10.56%	16.42%	55.54%
Indiana	11.83%	21.23%	79.38%
Iowa	n/a	20.02%	n/a
Kansas	n/a	15.31%	n/a
Kentucky	11.87%	20.68%	74.24%
Louisiana	n/a	19.32%	n/a
Maine	10.56%	16.43%	55.63%
Maryland	10.81%	17.37%	60.77%
Massachusetts	8.89%	12.96%	45.83%
Michigan	n/a	18.81%	n/a
Minnesota	9.67%	16.04%	65.87%
Mississippi	n/a	22.96%	n/a
Missouri	11.46%	19.12%	66.87%
Montana	8.80%	14.21%	61.45%
Nebraska	8.83%	18.19%	105.88%
Nevada	n/a	14.22%	n/a
New Hampshire	8.55%	13.30%	55.54%
New Jersey	n/a	15.05%	n/a
New Mexico	6.41%	14.82%	131.26%
New York	9.11%	16.33%	79.26%
North Carolina	9.89%	18.46%	86.59%
North Dakota	10.75%	17.45%	62.31%

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Table 1.1 (continued)

Percentage Obese by State in 1987 and 1997, and Percent Change,
The Behavioral Risk Factor Surveillance System

Independent Variables	Obese, 1987	Obese, 1997	Percent Change
Ohio	11.99%	17.37%	44.86%
Oklahoma	n/a	15.66%	n/a
Oregon	n/a	18.34%	n/a
Pennsylvania	n/a	17.83%	n/a
Rhode Island	8.51%	14.94%	75.61%
South Carolina	11.01%	16.68%	51.40%
South Dakota	11.50%	17.25%	49.98%
Tennessee	10.70%	17.61%	64.58%
Texas	10.64%	18.29%	71.93%
Utah	8.78%	14.24%	62.12%
Vermont	n/a	15.17%	n/a
Virginia	n/a	17.57%	n/a
Washington	10.20%	15.19%	48.93%
West Virginia	12.50%	19.88%	59.06%
Wisconsin	11.02%	17.07%	54.85%
Wyoming	n/a	15.57%	n/a

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Chapter 2

Essay: The Super Size of America:

An Economic Estimation of Body Mass Index and Obesity in Adults

"The drudgery of seeking subsistence has been supplanted for millions of people, not by abundance and indulgence, but rather by a new concept of what are necessities and needs."
– George Katona, *The Mass Consumption Society* (1964, p.6)

I. Introduction

The *New York Times* featured in its Book Review a book by Greg Critser entitled *Fat Land: How Americans Became the Fattest People in the World*, further shedding light on the obesity epidemic that has been prominently featured in the media. While obesity is not a new problem, it has recently surged into public consciousness. For most individuals, overweight and obesity result from a combination of excess caloric intake and inactivity (Koplan and Dietz 1999; Public Health Service 2001). The majority of Americans are now overweight (Must et al. 1999; Flegal et al. 2002). According to the USDA, Americans consumed 2,002 calories per day in 1994-1996, as opposed to 1,854 in 1977-1978 (Frazao 1999). While rates of overweight and obesity had remained steady until about 1980, since then overweight and obesity in the United States have spiraled out of control. This is an indication that genetics may not play such a large role in obesity, as genetic change does not occur so rapidly over time. According to Koplan and Dietz (1999), the gene pool in the United States has not changed significantly between 1980 and 1994. A study using twins has indicated that perhaps there is a much larger environmental effect in determining body weight than previously believed (Segal and Allison 2002).

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Second only to tobacco as the leading cause of premature death (McGinnis and Foege 1993), obesity and sedentary lifestyles are rapidly becoming the first. Obesity and sedentary lifestyles accounted for approximately 400,000 deaths in 2000, compared to 435,000 from cigarette smoking, 100,000 from alcohol abuse, and 20,000 from illegal drug use. They are related to such illnesses as coronary heart disease, stroke, high blood pressure, cancers of the colon, breast and prostate, and diabetes (Must et al. 1999; Mokdad et al. 2003). Obesity has also been associated with high cholesterol, menstrual irregularities, pregnancy complications, and psychological disorders such as depression (NIDDKD 1996). Known to many as adult-onset diabetes, type 2 diabetes is now not uncommon among children as a result of the obesity epidemic (Freedman et al. 1999). Obesity in adulthood has also been shown to reduce life expectancy, most notably at younger ages (Peeters et al. 2003; Fontaine et al. 2003).

This paper investigates the idea that the recent rapid increase in obesity rates is due to economic changes that have in turn caused behavioral changes in the lives of Americans. These changes in the environment have changed habits and redefined social and cultural norms. Changes in the surrounding environment have been numerous. The per capita number of restaurants increased by 61 percent between 1972 and 1997 (see Figure 2.1). Since more women are in the labor force today than in the 1970s, eating out has become more common as families are more encouraged to purchase food away from home. Technological changes have made for an easier lifestyle, and thus less physical activity is embedded into daily activities. Jobs have become more sedentary, contributing to the lack of physical activity that many experience. Many must now stray from their daily routines and pay for gym memberships in order to be more physically active.

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To study the determinants of body mass index and obesity, I employ pooled micro-level data from the First, Second, and Third National Health and Nutrition Examination Surveys. I augment these data using state-level policy variables pertaining to the number of restaurants, the gasoline tax, the cigarette tax, and clean indoor air laws. I find that the increase in the number of restaurants in particular increases obesity, and that female body mass index is responsive to changes in the cigarette tax.

II. Background and Literature Review

The prevalence of morbid obesity, the most severe form of obesity defined as a body mass index of 40 kg/m^2 or higher, increased from 0.78% in 1990 to 2.2% in 2000 (Freedman et al. 2002).[2] Body mass index (BMI) is the most convenient measure available in assessing overweight and obesity, its limitations being that it might overestimate body fat in athletes who have a muscular build and underestimate body fat in older people who have lost muscle mass (NIDDKD 1996).[3] Table 2.1 and Figure 2.2 show how average BMI and the percentage obese have changed over time in the four NHANES data sets.[4] The change between NHANES II and NHANES III is most notable, where a 57% increase occurs in the percentage of people who are obese. Average BMI goes up by 1.28 kg/m^2, or 5.1%, from 25.07 kg/m^2 to 26.35 kg/m^2. Table 2.2 shows differences across gender. This shows a 127% increase in the percentage of obese males between NHANES I and NHANES 99, and a 106% increase for females.

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[2] This estimate is based on self-reported measures from the Behavioral Risk Factor Surveillance System.

[3] Waist circumference might be an alternate measure of obesity, as a waist circumference of over 35 inches for women and 40 inches for men has been associated with a markedly increased likelihood of a variety of diseases (Janssen et al. 2002). However, waist circumference is not commonly measured in national public health data sets, and only NHANES III measures waist circumference.

[4] I do not use the most recent NHANES data in my analysis as the most current data available for the number of restaurants from the Census of Retail Trade is in 1997.

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The percentage of obese females, however, has remained consistently higher than the percentage of obese males.

Part of the tremendous increase in the obesity rate over time has been attributed to reductions in job strenuousness (Philipson 2001; Lakdawalla and Philipson 2002). Lakdawalla and Philipson use the National Health Interview Survey (1976-1994) and the National Longitudinal Survey of Youth (1982-1998) to show that decreases in job strenuousness over a long period of time are mainly responsible for increases in BMI over time. However, job strenuousness was relatively stable between the NHANES II and NHANES III time periods. The authors explain the rapid increase in the last two decades with changes in food prices. One disadvantage of their method is that they are forced to use self-reported measures of weight and height rather than actual measures, although they do attempt to correct for this.[5] Philipson (2001) points out that the American society has shifted from an agricultural one to a post-industrial one. This shift has been accompanied by innovations that economize on time spent in the household sector, such as convenience food for consumption. In addition, an increase in the variety of the food supply may contribute to the maintenance of obesity (Raynor and Epstein 2001).

Cawley (1999) has presented evidence suggesting that caloric intake is addictive. This is in line with findings that high-density fast food might indeed be addictive (Naik and Moore 1996; Schlosser 2001). Fat consumption in the United States has increased

[5] This method uses NHANES data, which contains both self-reported and actual measures of height and weight, and obtains age-gender-race-specific corrections. This is done by regressing the actual measure on the self-reported measure and its square and using the coefficient to adjust the self-reported measures in the data set being used. This is also the method used by Chou, Grossman, and Saffer (2002) in their study using the BRFSS. Yet there have been arguments that even this correction does not completely eliminate error and is not a perfect substitute for actual measures (see, for example, Plankey et al. 1997).

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(Ippolito and Mathios 1995; Frazao 1999). Evidence has also been put forth suggesting that obesity is associated with lower wages for women (Averett and Korenman 1996; Cawley forthcoming). The negative externalities that obese people impose on others has even been considered (Keeler et al. 1989).

The magnitude of the obesity epidemic begs the question as to why the increase has been so rapid, as well as what policy changes can be done in order to reverse this trend. Part of this question has been answered by previous research. This essay uses data covering a long time period, 1971-1994; in addition, I consider race and gender groups separately.

III. Analytical Framework

A household utility function such as that outlined by Becker (1965) provides a useful framework for assessing body mass index. Although people do not desire to be obese, some people gain more utility out of consuming food than others. People combine the obtaining of goods and services in the market with their own time to achieve objects that enter their utility functions – such as health, entertainment, and the enjoyment of eating palatable food.

We can think of the commodity good health (*G*) as entering the utility function of an individual directly. Among others, some of the additional commodities entering the utility function are caloric intake, activity, and smoking.

$$U = U(G, C, A, S; \varepsilon)$$

ε is composed of a vector of exogenous variables such as education, age, state of residence, race, and income. While these can be endogenized, we will treat them as

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exogenous or as predetermined at the very least.[6] Good health is a function of BMI and other determinants of good health, including but not limited to medical care (*M*):

$$G = G(BMI, M; E)$$

Good health is a quadratic function in BMI in the sense that values that are too low in addition to high values are undesired.[7] We can think of this as an inverted J-curve[8] which peaks in the normal BMI range (18.5-24.9 kg/m^2). When one has too high a BMI (BMI_{max}, at which the curve hits the x-axis), there is no utility received (severe illness and/or death).

BMI is in turn a function of caloric intake (*C*), activity level (*A*), smoking (*S*), and a vector of variables represented by ε, which includes age, thus taking into account the accumulation of body mass as one ages. Caloric intake has a positive effect on BMI, while activity level and smoking have negative effects. These variables in turn are dependent on market goods and time, which we shall combine into x for each variable. The following constraints are therefore imposed on our utility function:

$$\begin{aligned}
&BMI_t = BMI_{t-1} + f(C_{t-1}, A_{t-1}, S_{t-1}; \varepsilon) \\
&C = C(x_C; \varepsilon) \\
&A = A(x_A; \varepsilon) \\
&S = S(x_S; \varepsilon) \\
&I = P_C x_C + P_A x_A + P_S x_S + P_M x_M
\end{aligned}$$

Included in x_C are food at home, restaurant meals, and the time involved in consuming calories. Similarly, included in x_A are such "goods" as transportation, exercising at the

---

[6] Predetermined variables are variables that are uncorrelated with current and future error terms but may be correlated with past error terms.

[7] While obesity is associated with numerous illnesses, being too thin can also lead to health problems. Also, some people might desire not to be too thin as those with a higher BMI have fewer bone injuries and less osteoporosis when older.

[8] In medical literature, the J-curve refers to the graph showing the relationship between BMI and mortality. This curve (which looks like the letter J) dips in the normal range of BMI.

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gym, and the time involved in being active. Included in x_S could be variables such as cigarettes and clean indoor air laws. Those variables in x could be endogenous themselves. I represents income, and we assume that all income goes into producing good health.

A social welfare function might offer solutions to the obesity epidemic, where we would take into account the externalities and costs associated with obesity. If we were to internalize these costs through government intervention, by either increasing the cost of caloric intake or reducing the cost of physical activity, we might be closer to ameliorating this epidemic.

IV. Empirical Methodology

I use the National Health and Nutrition Examination Survey, which has an advantage over other data sets in that it contains actual measures of body mass index rather than self-reported measures. I use pooled data from 1971 to 1994.

Obesity (O) is a function of caloric intake, caloric expenditure, smoking, and a vector of variables that are specific to an individual and reflect that individual's predisposition towards obesity. Demand functions for caloric intake, caloric expenditure, and smoking are generated that depend on a set of exogenous variables as follows:

$$O = O(R, t_c, t_f, unemp, urban, E, A, G, S, H, M) \quad (1)$$

In equation (1), R represents restaurants, t_c is the cigarette tax, t_f is the food tax, *unemp* is the unemployment rate, *urban* is a dichotomous indicator of urbanization, E represents ethnic and racial background, A is age, G is gender, S denotes years of formal schooling completed, H is household income, and M represents marital status. I translate equation (1) into an empirical one through the following equation:

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$$O = \alpha_0 + \alpha_1 R + \alpha_2 R^2 + \alpha_3 t_c + \alpha_4 t_c^{\,2} + \alpha_5 t_f + \alpha_6 t_f^{\,2} + \alpha_7 unemp + \alpha_8 urban + \alpha_9 black$$
$$+ \alpha_{10} Hispanic + \alpha_{11} other + \alpha_{12} A + \alpha_{13} A^2 + \alpha_{14} male + \alpha_{15} elem + \alpha_{16} somehigh$$
$$+ \alpha_{17} high + \alpha_{18} somecoll + \alpha_{19} college + \alpha_{20} H + \alpha_{21} H^2 + \alpha_{22} married$$
$$+ \alpha_{23} divorced + \alpha_{24} widowed + \overline{\alpha_{25}}(years) + \overline{\alpha_{26}}(states) + u \quad (2)$$

Quadratic terms are included in equation (2) for the per capita number of restaurants, as well as for taxes, income, and age. This is to account for the likelihood that an additional unit at higher levels will have less of an effect on the dependent variables as that of an additional unit at lower levels.[9] *Black*, *Hispanic*, and *other* are dummy variables for race and ethinicity; *male* is a dummy variable for whether or not the respondent is male; *elem*, *somehigh*, *high*, *somecoll*, and *college* are dummy variables for years of schooling completed; *married*, *divorced*, and *widowed* are dummy variables for marital status; and *years* and *states* represent indicators for year of survey and state of residence, respectively; α_{25} and α_{26} thus represent vectors.

V. Micro-Level Data

To investigate the determinants of body mass index and obesity, I employ micro-level data from the First, Second, and Third National Health and Nutrition Examination Surveys (NHANES I, II, and III, respectively). These are national samples of the population of the United States ages 6 months to 74 years (NHANES I and II), and ages 2 months and over (NHANES III) with some oversampling of preschool children and the elderly in all three surveys; low-income families in NHANES I and II; women of childbearing ages in NHANES I; and blacks and Mexican Americans in NHANES III. The oversampling of low-income families in NHANES I and II results in the presence of more blacks in these surveys than in a random sample of the population of the United

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States. Similarly, the oversampling of blacks and Mexican Americans in NHANES III results in more low-income families than in a random sample. I focus in this essay on all adults 17 years of age and older. All three surveys were conducted by the National Center for Health Statistics (NCHS); NHANES I was conducted between 1971 and 1975; NHANES II was conducted between 1976 and 1980; and NHANES III was conducted between 1988 and 1994. Most states of the United States are represented in each survey.

VI. Dependent Variables

Body mass index (BMI), also termed Quetelet's index, is measured as weight in kilograms divided by height in meters squared, and is most commonly used in analyzing overweight and obesity. While there are various guidelines for defining overweight and obesity, I adopt the convention outlined by the National Institutes of Health in Clinical Guidelines (Public Health Service 2001). Following this method, an adult that is overweight is one with a BMI of 25 kg/m^2 or higher, while one that is obese has a BMI of 30 kg/m^2 or higher. Obesity characterized by a BMI between 30-34.9 is termed class 1 obesity, that between 35-39.9 class 2 obesity, and that greater than 40 kg/m^2 class 3 obesity, or morbid obesity. The dependent variables that I use are body mass index and the probability of being obese, where an obese respondent is one with a BMI of 30 kg/m^2 or higher.

VII. Independent Variables

The state-level variables included on the right-hand side of the equation pertain to the number of restaurants, the cigarette tax, the food tax, and the unemployment rate. Including more state-level variables would cause the model to be plagued by multicollinearity, as many policy variables are highly correlated.

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[9] In preliminary regressions, I find evidence that these continuous variables have non-linear effects.

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The per capita state-level number of restaurants is taken from the Census of Retail Trade. Frequency of fast food restaurant use has been shown to be associated with higher fat intake and greater body weight (French et al. 2000; Rolls and Hammer 1995; Public Health Service 2001), as fast food restaurants serve especially large portions (Nielsen and Popkin 2003). The Census of Retail Trade is part of the Economic Census and is collected every five years. The data I use are from 1972, 1977, 1982, 1987, 1992, and 1997. Fast food restaurants correspond to the Census category *refreshment places* while full service restaurants correspond to the Census category *restaurants and lunchrooms*. In 1997 this classification system changed; refreshment places became *limited service restaurants*, and restaurants and lunchrooms became *full service restaurants*. Since these categories did not exactly overlap, a correction was used based on national data that the Census collected for both categories. This correction thus involved multiplying the 1997 state-level values for *limited service restaurants* by the ratio of nation-wide *refreshment places* to *limited service restaurants*. Similarly, 1997 state-level values for *full service restaurants* were altered by multiplying these values by the national ratio of *restaurants and lunchrooms* to *full service restaurants*. Data for years not covered are linearly interpolated and extrapolated. The distinction between fast food and full service restaurants in the Census of Retail Trade is not clear-cut; many full service restaurants serve the type of high-caloric, inexpensive food that fast food restaurants serve. Therefore, the restaurant variable takes the sum of fast food restaurants, where in general people pay before eating, and full service restaurants, which in general provide waiter/waitress service.

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State taxes on food are obtained from *Facts and Figures on Government Finance*. These are taxes relative to the general sales tax, approximated by taking the food tax minus the general sales tax. (This value will therefore be negative if the state exempts food from taxation.) I expect the food tax to have a negative effect on body mass index and obesity.

Included among the right-hand side variables are state cigarette taxes. The cigarette taxes are taken from the Tax Burden on Tobacco. I expect BMI to be a positive function of cigarette taxes, as smoking has been used as a method of weight control (Fehily et al. 1984; Tomeo et al. 1999). A combination of federal and state tax hikes, clean indoor air laws forbidding smoking in designated areas, and the anti-smoking campaign have caused people to smoke less over time. This may be part of the reason for the increase in BMI over time, an unintended consequence of the anti-smoking campaign.

Data for the unemployment rate is from the Bureau of Labor Statistics website. Ruhm (2003) has shown that during economic downturns, health is actually improved. Using the unemployment rate and obesity as one (negative) health outcome, he finds an inverse relationship between the two. This is possibly because people who are unemployed have more time to take care of their weight or are more active. In my analysis I find that the unemployment rate has the expected sign but is insignificant for the most part.

Medical science has established the effects of caloric intake and physical activity on body mass index[10], and caloric intake and physical activity are poorly measured in

[10] For a relatively recent study on minority populations, see Bhargava and Guthrie (2002).

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NHANES[11]; I therefore estimate reduced form models. My main concern in this essay is the effect that the state-level variables – in particular, the number of restaurants – have on trends in the outcome variables, body mass index and obesity.

NHANES III has more detailed physical activity variables than either NHANES I or NHANES II; indicators for a variety of activities are given as well as the number of times each activity was performed in the past month. The activities are walking a mile without stopping, jogging, riding a bicycle, swimming, aerobics, dancing, calisthenics, garden work, lifting weights, and other exercise. (Respondents are allowed to choose up to four more types of exercise from a detailed list.) These activities were assigned intensity ratings according to a coding scheme developing by Ainsworth et al. (1993); intensity is measured as the ratio of metabolic rate when engaged in the activity to resting metabolic rate. Table 2.10 shows how increased intensity is correlated with a lower BMI.

VIII. Results

Table 2.3 shows means and standard deviations of the variables. Means employ NHANES sampling weights and are thus representative of the United States population during the time period analyzed. Racial categories are mutually exclusive. The omitted racial category is *white*; the omitted education category is *fewer than 8 years of formal schooling completed*, and the omitted marital status category is *single*.

Tables 2.4 and 2.5 show results where body mass index and obese are the dependent variables. Results are pooled as well as stratified by gender.[12] The per capita number of restaurants affects females more than males in both BMI and obesity regressions. This is a poignant result, as it could reflect the increased cost of time,

[11] Caloric intake is based on 24-hour recall, and the measures for physical activity are not consistent across the three NHANES data sets. I do, however, use these variables with some adjustments in my next essay.

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especially for women who are working more and have less time for meal preparation at home. (Using lagged values of restaurants per capita, body mass index for males and percentage of males who are obese are also affected by number of restaurants per capita.) The unemployment rate is negative, as expected, but not significant for the most part. The urban variable is consistently negative and significant; studies have shown that more urban areas tend to suffer less from obesity because of the degree of urban sprawl. Blacks, Hispanics, males, older people, and those who are married or widowed are more likely to have a higher BMI, while those with higher incomes and those with a college education are more likely to have a lower BMI.[13] While males are more likely to have a higher BMI, they are less likely to be obese, reflecting the way BMI tends to overestimate overweight and obesity in people with more muscular mass.[14] Looking at results for males and females separately reveals that males with higher incomes have a higher BMI. In Table 6 we see results by race for restaurants per capita.

Elasticities in Tables 2.8 and 2.9 are computed at sample means using the coefficients from the models in Tables 2.4 and 2.5. The elasticities of the state-level per capita number of restaurants are suggestive, as they are based on results which include time effects yet that nevertheless do not wipe out the effects of the policy variables. The restaurant elasticity on obesity is substantial, implying that as the number of restaurants increases by 1%, the probability of being obese increases by 0.222 percentage points. Evaluated at the mean, this would mean that a 1% increase in the number of restaurants per 10,000 population would increase the percentage of people who are obese from

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[12] Tests for changes in coefficients across gender and race are statistically significant at the 1% level.
[13] Numerous studies have established the positive effect that schooling has on health. See, for example, Grossman (1975) and Lleras-Muney (2002).
[14] Males are more likely to be overweight yet less likely to be obese.

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17.5% to 17.7%, a substantial increase.[15] We see that income lowers obesity; for a 1% increase in income, the probability of being obese is lowered by 0.043 percentage points. One can draw from this that those with higher incomes can afford healthier lifestyles.

The cigarette tax turns out to be positive, as expected, for the probability of being obese, though it is not significant. There is some concern about the interpretation of the cigarette tax, since it should only affect smokers and not non-smokers. However, as smoking status is available for most observations in NHANES, I also ran regressions with smoking on the right-hand side. Since smoking is clearly a choice variable and thus endogenous, I instrumented for smoking using the cigarette tax and its square, but the results were similar to the reduced-form equations.

IX. Discussion

Obesity is now a major epidemic in the United States that calls for immediate attention. The ready availability of inexpensive restaurants has not only caused people to consume more, but has made them less active – less likely to prepare food at home or travel further distances to obtain a healthy meal. The existence of numerous restaurants per capita facilitates caloric intake. Besides, genetically, man is conditioned to consume in order to live well.[16] Technological "advances" that have made daily chores easier discourage physical activity, as does work that has become more sedentary over time.

We can see the rapid increase in obesity over time, especially during the 1980s, to be due in part to the great increase in the number of restaurants, and partly an unintended consequence of the campaign to reduce smoking. The increased number of restaurants could reflect the increased value of time for women. A possible source of concern is the

[15] Since the obese regressions were probit ones, the coefficients were multiplied by a factor of 0.4 in calculating the elasticities to make them comparable to LPM coefficients.

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potential endogeneity of the number of restaurants, as previously mentioned. Restaurants, for example, are not randomly distributed, but might locate themselves in areas with higher BMIs, and/or be correlated with income. This worry can be reduced somewhat when we see that the rise in restaurants began before the rise in obesity (Figures 2.1 and 2.2).[17] I also took averages for the three NHANES data sets, making the state the unit of observation, and differenced them such that:

$$\Delta BMI_{NHANES_i} = f(\Delta restaurants_{NHANES_i}), \text{ where } i=1,2,3.$$

Results are shown in Table 2.11, where we see that the change in the per capita number of restaurants between NHANES has a positive and significant effect on BMI, and remains so when analyzed at the mean.

Changes across gender and race are also important when analyzing BMI and obesity, which I have addressed in this paper. Possible solutions to the obesity problem might include publicly financed education about dieting and exercise, although health information does not seem be lacking (Philipson 2001). If obesity is not only bad for one's health but imposes negative externalities on others, as do cigarettes, then taxing food might be a solution.[18] What is disturbing is that public schools are provided with more money from the fast food industry than the government can give, thus causing a junk food infiltration in the public school system, getting children hooked early. In

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[16] Obesity was once associated with wealth and power.

[17] I experimented with lagged restaurants per capita (lagged three years) and found that they were even more significant than current fast food restaurants in predicting body mass index and obesity, usually at the 1% level not only for the pooled model and for females, but also for males. Tables 2.6 and 2.7, where results for restaurants are shown by gender and race, include lagged restaurant terms. Using instrumental variables, such as female labor force participation, in an attempt to correct for the possible omitted variables bias that exists is risky, as most instruments are weak and do not pass tests for exclusion restrictions.

[18] As Philipson suggests, taxing food would be a regressive move, affecting the poor more than the rich (Mitka 2003). He suggests subsidizing physical activity and/or tax breaks to people joining health clubs or businesses that provide exercise opportunities to their workers.

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addition, because of budget cuts, often exercise programs in schools are cut, decreasing physical activity. If habits such as eating healthily and being physically active are formed from childhood, maybe our primary focus should be on schools. Yet massive government intervention is not necessarily required. We realize that obesity is a health problem, and may be one of the costs of economic progress. We have identified the problem and recognized that we have a serious epidemic; finding a solution should be high on the people's agendas.

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Table 2.1

Trends in Body Mass Index and the Percentage Obese,
Persons 17 Years of Age and Older

Survey	Period	Body Mass Index	Percentage Obese
NHANES I	1971-1975	25.06	13.62
NHANES II	1976-1980	25.07	13.67
NHANES III	1988-1994	26.35	21.47
NHANES 99	1999-2000	27.77	29.19

Survey weights are employed in all computations.

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Table 2.2

Trends in Body Mass Index and the Percentage Obese,
Persons 17 Years of Age and Older, By Gender

		Males		Females	
Survey	Period	Body Mass Index	Percentage Obese	Body Mass Index	Percentage Obese
NHANES I	1971-1975	25.33	11.31	24.81	15.71
NHANES II	1976-1980	25.22	11.36	24.94	15.78
NHANES III	1988-1994	26.41	18.86	26.29	23.85
NHANES 99	1999-2000	27.49	25.69	28.04	32.43

Survey weights are employed in all computations.

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Table 2.3

Definitions, Means, and Standard Deviations of Variables

Variable	Definition	*Pooled (n=30335)* Mean (Standard Deviation)	*Males (n=14585)* Mean (Standard Deviation)	*Females (n=15750)* Mean (Standard Deviation)
Body mass index	Weight in kilograms divided by height in meters squared	25.739 (5.336)	25.867 (4.517)	25.615 (6.023)
Obese	Dichotomous variable that equals 1 if body mass index is equal to or greater than 30	0.175 (0.380)	0.153 (0.360)	0.197 (0.397)
Smoke	Dichotomous variable that equals 1 if respondent smokes, and 0 otherwise	0.347 (0.476)	0.380 (0.486)	0.314 (0.464)
Black non-Hispanic	Dichotomous variable that equals 1 if respondent is black but not Hispanic	0.105 (0.307)	0.098 (0.298)	0.112 (0.316)
Hispanic	Dichotomous variable that equals 1 if respondent is Hispanic	0.070 (0.255)	0.068 (0.252)	0.072 (0.258)
Other race	Dichotomous variable if respondent's race is other than white, black, or Hispanic	0.026 (0.160)	0.027 (0.163)	0.025 (0.157)
Male	Dichotomous variable that equals 1 if respondent is male	0.493 (0.500)		
Elementary	Dichotomous variable that equals 1 if respondent completed 8 years of formal schooling	0.055 (0.229)	0.060 (0.237)	0.051 (0.221)
Some high school	Dichotomous variable that equals 1 if respondent completed at least 9 years but fewer than 12 years of formal schooling	0.164 (0.371)	0.166 (0.372)	0.162 (0.369)
High school graduate	Dichotomous variable that equals 1 if respondent completed exactly 12 years of formal schooling	0.348 (0.476)	0.314 (0.464)	0.381 (0.486)
Some college	Dichotomous variable that equals 1 if respondent completed at least 13 years but fewer than 16 years of formal schooling	0.181 (0.385)	0.174 (0.379)	0.187 (0.390)
College graduate	Dichotomous variable that equals 1 if respondent graduated from college	0.168 (0.374)	0.199 (0.399)	0.138 (0.344)
Married	Dichotomous variable that equals 1 if respondent is married	0.638 (0.480)	0.685 (0.465)	0.593 (0.491)
Divorced	Dichotomous variable that equals 1 if respondent is divorced or separated	0.092 (0.289)	0.064 (0.245)	0.119 (0.324)
Widowed	Dichotomous variable that equals 1 if respondent is widowed	0.057 (0.232)	0.020 (0.142)	0.093 (0.290)

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Table 2.3 (continued)

Definitions, Means, and Standard Deviations of Variables

Variable	Definition	*Pooled (n=30335)* Mean (Standard Deviation)	*Males (n=14585)* Mean (Standard Deviation)	*Females (n=15750)* Mean (Standard Deviation)
Household income	Real household income in tens of thousands of 1982-84 dollars	2.978 (2.427)	3.149 (2.468)	2.813 (2.375)
Age	Age of respondent	41.968 (16.635)	41.707 (16.307)	42.222 (16.945)
Urban	Dichotomous variable that equals 1 if respondent is living in an urban area (defined as central or fringe counties of metro areas with a population of 1 million or more)	0.590 (0.492)	0.589 (0.492)	0.591 (0.492)
Restaurants	Number of fast-food restaurants and full-service restaurants per ten thousand persons in respondent's state of residence	11.607 (2.250)	11.551 (2.264)	11.661 (2.235)
Lagged restaurants	Restaurants lagged 3 years	11.041 (2.271)	11.035 (2.287)	11.046 (2.256)
Cigarette tax	Real state cigarette tax in 1982-84 cents	20.565 (8.935)	20.853 (9.039)	20.285 (8.823)
Food tax	General state sales tax on food minus general state sales tax (negative if state exempts food)	-3.533 (3.350)	-3.611 (3.443)	-3.457 (3.255)
Unemployment rate	Unemployment rate in respondent's state of residence	6.589 (1.479)	6.561 (1.485)	6.617 (1.472)

Standard deviation is reported in parentheses. NHANES sample weights are used in calculating the mean and standard deviation.

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Table 2.4

Body Mass Index Regressions, Persons 17 Years of Age and Older

Independent Variables	(1) Pooled	(2) Males	(3) Females
Restaurants	0.652**	0.258	1.015**
	(0.318)	(0.366)	(0.501)
Restaurants squared	-0.025**	-0.001	-0.050***
	(0.010)	(0.014)	(0.017)
Cigarette tax	0.038	0.026	0.052
	(0.044)	(0.050)	(0.073)
Cigarette tax squared	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Food tax	-0.144**	-0.089	-0.225***
	(0.065)	(0.089)	(0.081)
Food tax squared	-0.007	-0.003	-0.013
	(0.007)	(0.009)	(0.009)
Unemployment rate	-0.120**	-0.130	-0.135*
	(0.059)	(0.080)	(0.080)
Urban	-0.469***	-0.612***	-0.325*
	(0.105)	(0.123)	(0.166)
Black non-Hispanic	1.519***	0.365**	2.552***
	(0.144)	(0.166)	(0.201)
Hispanic	0.935***	0.393	1.380***
	(0.182)	(0.248)	(0.227)
Other race	-1.316***	-1.656***	-1.100**
	(0.367)	(0.344)	(0.514)
Age	0.336***	0.276***	0.379***
	(0.017)	(0.020)	(0.022)
Age squared	-0.003***	-0.003***	-0.003***
	(0.0002)	(0.0002)	(0.0002)
Male	0.391***		
	(0.099)		
Elementary	-0.098	0.110	-0.332
	(0.176)	(0.226)	(0.297)
Some high school	0.045	0.225	-0.325
	(0.177)	(0.198)	(0.279)
High school graduate	-0.027	0.494**	-0.743***
	(0.186)	(0.195)	(0.267)
Some college graduate	-0.378**	0.429**	-1.338***
	(0.179)	(0.205)	(0.285)
College graduate	-1.071***	-0.262	-2.293***
	(0.188)	(0.193)	(0.290)
Household income	-0.167**	0.209**	-0.469***
	(0.074)	(0.093)	(0.123)
Household income squared	0.012	-0.021**	0.037**
	(0.008)	(0.009)	(0.014)
Married	0.400***	0.838***	0.043
	(0.144)	(0.157)	(0.230)

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Table 2.4 (continued)

Body Mass Index Regressions, Persons 17 Years of Age and Older

Independent Variables	(1) Pooled	(2) Males	(3) Females
Divorced	-0.187	-0.185	-0.464*
	(0.179)	(0.245)	(0.243)
Widowed	0.560**	0.601*	-0.239
	(0.225)	(0.334)	(0.286)
Constant	13.264***	17.093***	14.214***
	(2.257)	(2.655)	(4.196)
R-square	0.097	0.107	0.124
Sample size	30335	14585	15750

Note: All regressions include state and year dummies. All regressions employ sample weights. Standard errors are in parentheses. Huber (1967) or robust standard errors on which they are based allow for state/year clustering.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 2.5

Probit Obese Regressions, Persons 17 Years of Age and Older

Independent Variables	(1) Pooled	(2) Males	(3) Females
Restaurants	0.187**	0.118	0.249*
	(0.085)	(0.105)	(0.137)
Restaurants squared	-0.006**	-0.001	-0.011**
	(0.003)	(0.004)	(0.005)
Cigarette tax	0.004	0.013	-0.008
	(0.014)	(0.020)	(0.021)
Cigarette tax squared	-0.00006	-0.0003	0.0002
	(0.0003)	(0.0004)	(0.0004)
Food tax	-0.046**	-0.032	-0.062***
	(0.021)	(0.033)	(0.024)
Food tax squared	-0.003	-0.002	-0.006**
	(0.002)	(0.003)	(0.003)
Unemployment rate	-0.002	-0.001	-0.004
	(0.017)	(0.024)	(0.024)
Urban	-0.097***	-0.166***	-0.034
	(0.028)	(0.038)	(0.040)
Black non-Hispanic	0.289***	0.114**	0.423***
	(0.038)	(0.050)	(0.052)
Hispanic	0.142***	0.077	0.194***
	(0.052)	(0.084)	(0.067)
Other race	-0.258**	-0.454***	-0.135
	(0.101)	(0.157)	(0.133)
Age	0.065***	0.055***	0.073***
	(0.005)	(0.008)	(0.005)
Age squared	-0.001***	-0.001***	-0.001***
	(0.00004)	(0.00008)	(0.00005)
Male	-0.135***		
	(0.027)		
Elementary	-0.039**	0.005	-0.065
	(0.045)	(0.073)	(0.065)
Some high school	-0.008	0.039	-0.066
	(0.042)	(0.064)	(0.061)
High school graduate	-0.042	0.092	-0.168***
	(0.048)	(0.067)	(0.059)
Some college graduate	-0.151***	0.014	-0.295***
	(0.049)	(0.071)	(0.066)
College graduate	-0.340***	-0.190***	-0.520***
	(0.055)	(0.073)	(0.073)
Household income	-0.060**	-0.010	-0.087**
	(0.027)	(0.041)	(0.034)
Household income squared	0.004	0.0001	0.006
	(0.003)	(0.004)	(0.004)
Married	0.111**	0.183***	0.050
	(0.051)	(0.066)	(0.069)

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Table 2.5 (continued)

Probit Obese Regressions, Persons 17 Years of Age and Older

Independent Variables	(1) Pooled	(2) Males	(3) Females
Divorced	0.019	-0.078	0.021
	(0.056)	(0.095)	(0.065)
Widowed	0.117*	0.076	0.041
	(0.070)	(0.142)	(0.077)
Constant	-3.893***	-3.621***	-4.038***
	(0.672)	(0.950)	(0.990)
R-square	0.060	0.055	0.077
Sample size	30335	14585	15750

Note: All regressions include state and year dummies. All regressions employ sample weights. Standard errors are in parentheses. Huber (1967) or robust standard errors on which they are based allow for state/year clustering.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 2.6

Male Body Mass Index and Obese Regressions, Effect of Restaurants, by Race

Dependent variable: BMI

Independent Variables	(1) White Males (n=9061)	(2) Black Males (n=2894)	(3) Hispanic Males (n=2625)
Restaurants	0.161	1.533	3.009*
	(0.529)	(1.165)	(1.675)
Restaurants squared	0.001	-0.037	-0.144*
	(0.020)	(0.047)	(0.074)
Lagged restaurants	1.260*	2.676***	5.065*
	(0.744)	(0.979)	(2.741)
Lagged restaurants squared	-0.064*	-0.138***	-0.200
	(0.033)	(0.038)	(0.125)

Dependent variable: Obese

Independent Variables	(1) White Males	(2) Black Males	(3) Hispanic Males
Restaurants	0.116	0.230	1.369
	(0.134)	(0.514)	(0.938)
Restaurants squared	-0.002	-0.003	-0.062
	(0.004)	(0.021)	(0.040)
Lagged restaurants	0.643***	0.826*	4.413***
	(0.247)	(0.426)	(1.221)
Lagged restaurants squared	-0.030***	-0.046***	-0.196***
	(0.011)	(0.017)	(0.051)

Note: All regressions include state and year dummies, as well as controls for urbanization, race/ethnicity, age, education, divorced and widowed marital status, the state cigarette and food taxes, and the state unemployment rate. All regressions employ sample weights.
Standard errors are in parentheses. Huber (1967) or robust standard errors on which they are based allow for state/year clustering.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 2.7

Female Body Mass Index and Obese Regressions, Effect of Restaurants, by Race

Dependent variable: BMI

Independent Variables	(1) White Females *(n=9588)*	(2) Black Females *(n=3351)*	(3) Hispanic Females *(n=2717)*
Restaurants	0.594	-0.894	2.294
	(0.643)	(1.520)	(2.927)
Restaurants squared	-0.031	0.031	-0.101
	(0.020)	(0.061)	(0.124)
Lagged restaurants	1.980**	1.130	1.828
	(0.870)	(1.230)	(2.553)
Lagged restaurants squared	-0.099**	-0.045	-0.069
	(0.040)	(0.047)	(0.093)

Dependent variable: Obese

Independent Variables	(1) White Females	(2) Black Females	(3) Hispanic Females
Restaurants	0.208	-0.147	0.164
	(0.172)	(0.239)	(1.114)
Restaurants squared	-0.009	0.010	-0.014
	(0.006)	(0.009)	(0.054)
Lagged restaurants	0.292	-0.072	-0.382
	(0.236)	(0.340)	(0.657)
Lagged restaurants squared	-0.015	0.004	0.019
	(0.011)	(0.012)	(0.025)

Note: All regressions include state and year dummies, as well as controls for urbanization, race/ethnicity, age, education, divorced and widowed marital status, the state cigarette and food taxes, and the state unemployment rate. All regressions employ sample weights.
Standard errors are in parentheses. Huber (1967) or robust standard errors on which they are based allow for state/year clustering.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 2.8

Elasticities of Body Mass Index and the Probability of Being Obese
With Respect to Selected Variables

Independent Variable	Body Mass Index	Obesity Probability
Restaurants	0.032	0.222
Cigarette tax	-0.003	0.013
Income	-0.011	-0.043
Age	0.137	-0.318

Computed at weighted sample means.

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Table 2.9

Elasticities of Body Mass Index and the Probability of Being Obese
With Respect to Selected Variables, by Gender

	Males		*Females*	
Independent Variable	Body Mass Index	Obesity Probability	Body Mass Index	Obesity Probability
Restaurants	0.105	0.438	-0.069	-0.035
Cigarette tax	-0.013	0.004	0.009	0.0009
Income	0.009	-0.012	-0.029	-0.060
Age	0.042	-0.474	0.207	-0.193

Computed at weighted sample means.

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Table 2.10

Body Mass Index and the Percentage Obese,
Persons 17 Years of Age and Older,
By Activity Intensity in NHANES III

Activity Intensity	Percent of Sample	Body Mass Index	Percentage Obese
No intensity	23.22	27.44	28.46
0.1~49.9	28.02	26.99	25.81
50~99.9	12.11	26.12	20.03
100~149.9	11.56	25.82	18.85
150~199.9	9.16	25.74	15.25
200~299.9	7.78	25.68	16.73
Greater than 300	8.14	25.04	14.42

Survey weights are employed in all computations.

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Table 2.11

Effect of the Change Number of Restaurants Per 10,000 Population
Between NHANES on Body Mass Index,
Persons 17 Years of Age and Older

	Body Mass Index
Restaurants	1.1394**
	(0.4628)
Restaurants squared	-0.0323*
	(0.0190)
Restaurants	0.7927*
	(0.4490)
Restaurants squared	-0.0131
	(0.0173)

Note: Lower regressions include controls for gender, race/ethnicity, age, education, and marital status. Standard errors are in parentheses.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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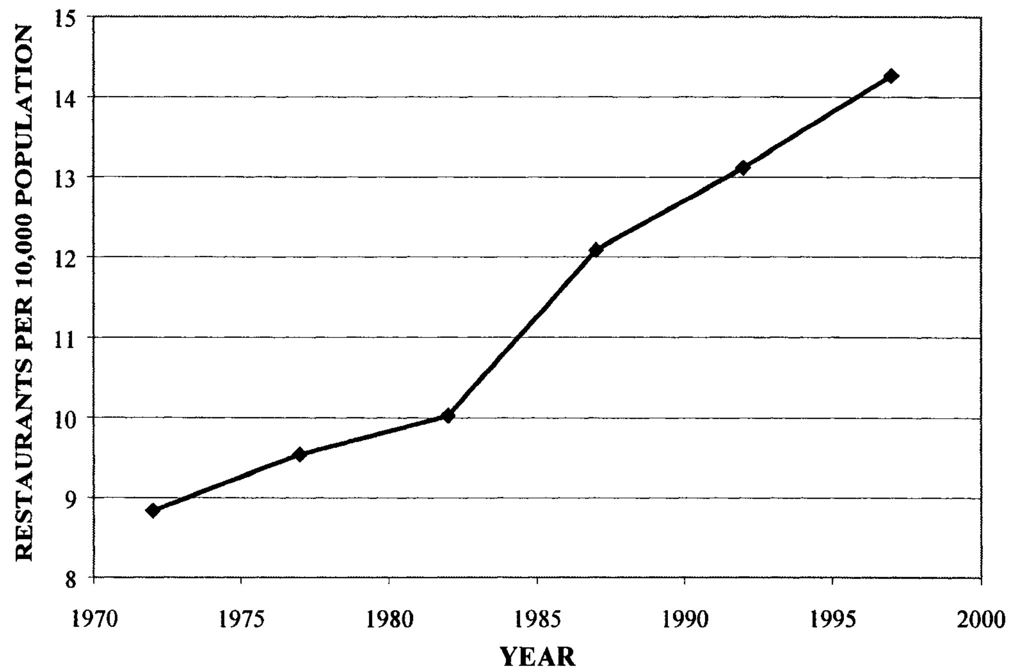
Figure 2.1

Restaurants per 10,000 population, 1972-1997



Source: Bureau of the Census (various years)

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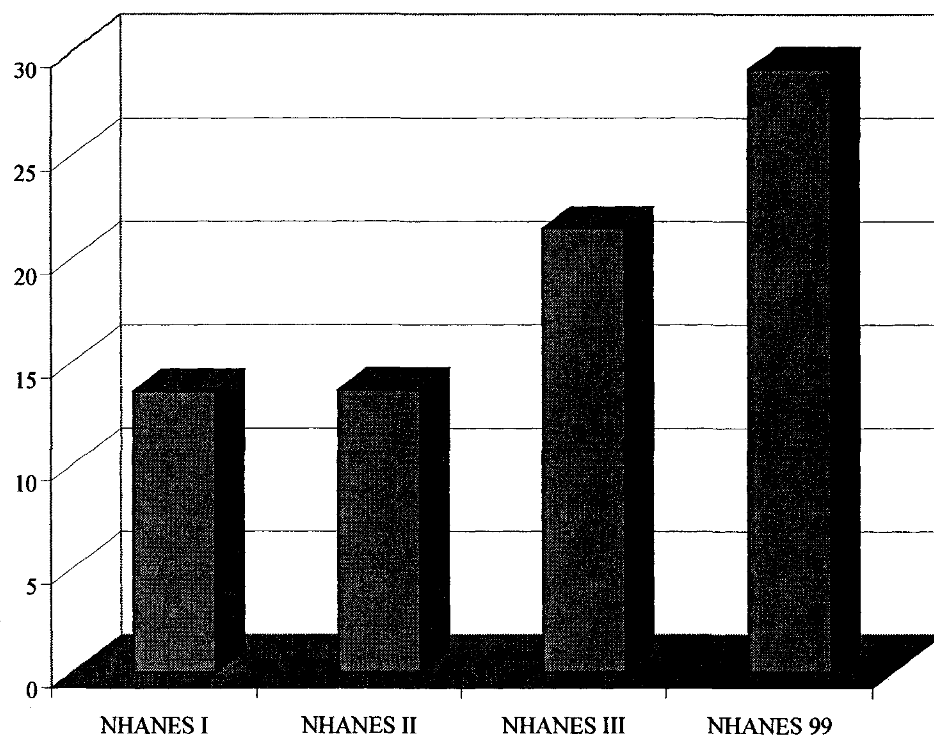
Figure 2.2

Percentage Obese, Ages 17 and over, NHANES I, II, III, and 99



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Chapter 3

Essay: Structural Estimation of Caloric Intake, Exercise, Smoking and Obesity

I. Introduction

According to the National Health and Nutrition Examination Survey, the percentage of individuals classified as obese in the United States increased by 67 percent between 1971 and 1994, my period of analysis, with most of this increase occurring during the 1980s. Obesity is the second most important cause of premature death (McGinnis and Foege 1993; Allison et al. 1999). The increase in obesity does not reflect a change in the genetic make-up of the United States, since the gene pool did not change significantly between 1990 and 1994 (Koplan and Dietz 1999). This paper explores the idea that the recent rapid increase in obesity rates are due to economic changes that have in turn changed the amount Americans eat, exercise, smoke, and do other things that affect their weight. In addition, since demographic characteristics and socioeconomic status influence overweight and obesity, I consider the effect of demographic changes on trends in obesity.

In order to study the determinants of a person's body mass index, which, as explained below, is often used as a measure of obesity, I employ pooled micro-level data from the First, Second, and Third National Health and Nutrition Examination Surveys. I augment these data using state-level data on the number of restaurants, the price of restaurant meals, death rates from heart disease by age group and gender, annual temperature, the gasoline tax, the general sales tax on food, population density, cigarette prices, and clean indoor air laws.

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II. Background

Obesity and sedentary lifestyles are second only to smoking as the leading cause of premature death (McGinnis and Foege 1993; Allison et al. 1999). They have been linked to coronary heart disease, stroke, high blood pressure, cancers of the colon, breast and prostate, and diabetes (Must et al. 1999; Mokdad et al. 2003). Obesity has also been associated with high cholesterol, menstrual irregularities, pregnancy complications, and psychological disorders such as depression (NIDDKD 1996). Type 2 diabetes, once termed adult-onset diabetes, is now not uncommon in children as a result of the obesity epidemic (Freedman et al. 1999). Recently obesity in adulthood has been shown to reduce life expectancy, especially among persons obese in their youth (Peeters et al. 2003; Fontaine et al. 2003). Economic costs related to overweight and obesity were estimated to be $99.2 billion as of 1995 (Wolf and Colditz 1998).

There has been much debate as to what constitutes a proper diet, and recently it was suggested that the USDA's Food Guide Pyramid be replaced with an alternative that stresses vitamin intake and whole wheat foods, the so-called Healthy Eating Pyramid (McCullough et al. 2002; Willett 2001). Excess carbohydrates in the body have been shown to be converted to fat. Measurements of the glycemic index in the body, which measures the rate of carbohydrate absorption after a meal, has shed light on the importance of controlling the intake of carbohydrates as well as that of fat, a high glycemic index being what contributes to obesity (Ford and Liu 2001; Ludwig 2002). Since the carb-to-lipid ratio might not be so important, it seems to make more sense to focus on total caloric intake rather than, say, intake of calories from fat.

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Drugs intended to reduce weight have become popular, with a rapid increase since 1990. In one study, phentermine, sibutramine, and orlistat (more commonly known under their brand names of Ionamin, Meridia, and Xenical, respectively) were shown to reduce weight by 8.1%, 5.0%, and 3.4%, respectively, in trials lasting 36 to 52 weeks (Glazer 2001). In 1997 over 10 million prescriptions were written for "phen-fen" (phentermine-fenfluramine) before the recall in September of 1997 of fenfluramine and dexfenfluramine, which were found to cause heart valve damage in 30% of patients. Surgeries such as gastric bypass surgery are only recommended for the morbidly obese and have numerous surgical risks associated with them. In addition, patients undergoing surgery often do not achieve their desired weight and are put under lifelong medical surveillance (Livingston 2002; Brolin 2002). More is being studied about genes and hormones that play a role in regulating body weight. Ghrelin, a hormone primarily produced in the stomach, increases food intake and is strongly responsible for why dieters often gain weight that they have lost (Cummings et al. 2002). The body interprets dieting as starving, and increases its secretion of ghrelin, slowing down metabolism. Sure enough, severely elevated or lowered body weight is associated with offsetting metabolic processes that oppose the maintenance of an altered body weight (Leibel et al. 1995). Low levels of leptin are also associated with obesity (Heymsfield et al. 1999). Injecting obese subjects with leptin as a cure is being looked into.[19]

In analyzing overweight and obesity, I use body mass index (BMI), measured as weight in kilograms divided by height in meters squared. BMI is convenient as it is routinely measured in physical examinations. Yet BMI might overestimate body fat in

[19] This has largely been ineffective as the severely overweight tend to be leptin-resistant.

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athletes who have a muscular build and underestimate body fat in older people who have lost muscle mass (NIDDKD 1996).

Due to the importance of the obesity epidemic, there is a pressing need for answers as to why its increase has been so rapid, as well as what can be done in order to rectify or reverse this trend.

III. Analytical Framework

The model of this paper follows a similar reasoning and theoretical approach as that of Chou et al. (2004). I go further in this paper in that I estimate instrumental variables models and focus on analyzing demographic determinants of obesity. Differences across gender and race are also considered, as differences in coefficients across gender and race were significant at the one percent level when tested. I briefly summarize the framework below.

Energy balance at time t (E_t) is defined as caloric intake (C_t) minus energy expenditure or activity level (A_t):

$$E_t = C_t - A_t \qquad (1)$$

Body mass index (*BMI*) is a function of the sum of energy balance in all periods, as well as a vector of variables (ε) that are specific to an individual and reflect that individual's predisposition towards obesity:

$$BMI = f(\sum_t E_t, \varepsilon) \qquad (2)$$

If caloric intake and physical activity offset each other in each period, one would expect the individual to have a constant body weight. The vector of variables (ε) include determinants such as education, age, state of residence, race, and income. These variables influence the process by which a person converts caloric intake into caloric

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expenditure (via activity) and thus affect a person's body mass and predisposition towards obesity. While no one desires to be obese, some people gain more utility out of consuming food than others. People combine the obtaining of goods and services in the market with their own time to achieve objects that enter their utility functions – such as health, entertainment, and the enjoyment of eating palatable food. Energy expenditure is measured by physical activity. The importance of activity is highlighted in a large literature (see, for example, Hill 1997; Public Health Service 2001; USDHHS 2000), and now the recommended regimen has been increased from half an hour of exercise three times a week to a full hour (USDHHS 2000). I expect smoking to be a negative function of BMI, as smoking has been used as a method of weight control (Philipson 2001; Chou et al. 2004; Fehily et al. 1984; Tomeo et al. 1999). A combination of federal and state tax hikes, clean indoor air laws forbidding smoking in designated areas, and the anti-smoking campaign have caused people to smoke less over time; this may be part of the reason for the increase in BMI over time.

IV. Empirical Implementation

In order to account for the potential endogeneity of caloric intake, activity level, and smoking, I estimate structural equations where body mass index is the outcome of interest in addition to models where these variables are treated as exogenous. Means for the variables I use in my regressions are shown in Table 3.1. Activity-adjusted caloric intake and smoking are functions of a vector of instruments Z, as well as exogenous variables X. Included in Z are state-level variables pertaining to the number of restaurants, the price of restaurant meals, death rates from heart disease by age group and gender, annual temperature, the gasoline tax, the general sales tax on food, cigarette prices, and clean

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indoor air laws. I translate equation (2) into an empirical one by estimating the following:

$$BMI = \alpha_0 + \alpha_1 AC + \alpha_2 S + \alpha_3 X + u_1 \qquad (3)$$

Equation (3) represents the primary equation of interest, treating activity-adjusted caloric intake (*AC*) – to be defined later – and smoking (*S*) as exogenous right-hand side variables. I also estimate structural equations, where *AC* and *S* are treated as endogenous variables and their predicted values are obtained after regressing them on all the exogenous variables. Theoretically, since caloric intake, energy expenditure, and smoking are inputs in the production of body mass index, they should be treated as endogenous. The above equations are estimated independently by ordinary least squares and by two-stage least squares for the whole sample as well as by gender and race; results are shown in Tables 3.2 and 3.3. In addition, ordinary least squares results are shown for gender/race subsamples in Table 3.4.

The effectiveness of instrumental variables procedures crucially depends on the validity of the instruments. In order to test the validity of the exclusion restrictions (to ensure that the instruments significantly affect activity-adjusted caloric intake and smoking, but not BMI), I employ the overidentification test suggested by Davidson and MacKinnon (1993). In this test, the residual of the 2SLS model is regressed on all exogenous variables. The value of r-squared that results, when multiplied by the number of observations, follows a chi-square distribution with degrees of freedom equal to the degree of overidentification. The null is that the instruments are valid. In all cases the null hypothesis could not be rejected, suggesting that the instruments were valid. I also check that the instruments are jointly significant in first-stage equations, and find that

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they are at the 1% level. Hausman tests for the consistency of the OLS models relative to the 2SLS models reveal that the OLS models are consistent.

Micro-level data from the First, Second, and Third National Health and Nutrition Examination Surveys (NHANES I, II, and III, respectively) are used in this analysis. These are national samples of the population of the United States ages 6 months to 74 years (NHANES I and II), and ages 2 months and over (NHANES III) with some oversampling of preschool children and the elderly in all three surveys; low-income families in NHANES I and II; women of childbearing ages in NHANES I; and blacks and Mexican Americans in NHANES III. The oversampling of low-income families in NHANES I and II results in the presence of more blacks in these surveys than in a random sample of the population of the United States. Similarly, the oversampling of blacks and Mexican Americans in NHANES III results in more low-income families than in a random sample. All three surveys were conducted by the National Center for Health Statistics; NHANES I between 1971 and 1975; NHANES II between 1976 and 1980; and NHANES III between 1988 and 1994. Most states of the United States are represented in each survey. I focus in this paper on all adults 17 years of age and older, who typically control their caloric intake.

Each subject in the surveys received a detailed physical examination including measurement of height and weight. Caloric intake was computed from detailed food consumption during the previous 24 hours reported by the respondent. Since this is a self-reported variable, and likely to have similar under- and over-reporting as BMI, I adjust caloric intake by multiplying it by the ratio of actual to self-reported BMI. Physical activity is measured using the answer to the survey question, "In your usual day,

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aside from recreation, how active are you?" for NHANES I and NHANES II (answer choices are very active, moderately active, and quite inactive), and "Compared with most (men/women) your age, would you say you are more active, less active, or about the same?" for NHANES III. I recognize the possible shortcomings of using answers to a slightly differently-phrased question for the same variable. NHANES III has much more detailed data on activity, which I cannot use in a pooled model. Smoking is measured using a dichotomous indicator for whether or not the person is currently smoking.

Caloric intake not only influences BMI but is also likely to be influenced by BMI, especially if caloric intake is habituating. I identify caloric intake by using the state-level number of restaurants, the price of restaurants, the mortality rate from heart disease, and the general sales tax on food. Frequency of fast food restaurant use has been shown to be associated with higher fat intake and greater body weight (French et al. 2000; Rolls and Hammer 1995; Public Health Service 2001), as fast food restaurants serve especially large portions (Nielsen and Popkin 2003). According to the Census of Retail Trade, the per capita number of restaurants increased by 61 percent between 1972 and 1997. The ready availability of cheap, prepared food greatly reduces the time cost associated with eating, especially important now that more females have entered the labor force. Since time is a scarce resource, females have incentives to substitute away from time-intensive activities such as food preparation as the value of time has gone up. Heart disease mortality can have an influence on a person's behavior, and therefore his or her BMI. An individual residing in an area with a high mortality rate from heart disease for his or her age group is likely to alter his behavior by lowering caloric intake and increasing activity.

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Information on the number of fast food restaurants and full service restaurants, as well as information on the average price of a meal at restaurants, is collected from the Census of Retail Trade (Bureau of the Census, various years). The Census of Retail Trade is part of the Economic Census and is collected every five years. The data I use are from 1972, 1977, 1982, 1987, 1992, and 1997. Fast food restaurants correspond to the Census category *refreshment places* while full service restaurants correspond to the Census category *restaurants and lunchrooms*. In 1997 this classification system changed; refreshment places were analogous to *limited service restaurants*, and restaurants and lunchrooms were analogous to *full service restaurants*. Since these categories did not exactly overlap, a correction was used based on national data that the Census collected for both categories. Data for years not covered are linearly interpolated and extrapolated. The restaurant variable takes the sum of fast food restaurants, where people in general pay before eating, and full service restaurants, which in general provide waiter/waitress service. The restaurant price variable takes the average of the prices of these restaurants, weighted by the number of restaurants in each category. Information on mortality from various diseases of the heart is obtained from the *Centers for Disease Control and Prevention of the National Institutes of Health.* Age groups are: 15-19, 20-24, 25-34, 45-54, 55-64, 65-74, 75-84, and 85 and over. I merged the heart disease mortality rates with my data according to age group and gender. State taxes on food are obtained from *Facts and Figures on Government Finance.* These are taxes relative to the general sales tax, approximated by taking the food tax minus the general sales tax. (This value will therefore be negative if the state exempts food from taxation.)

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For similar reasons as those for caloric intake, physical activity is also likely to be endogenous. Instruments for physical activity include annual temperature, the gasoline tax, and county population density. Annual temperature pertains to the mean 1976 temperature in the state of residence. Population density is 1994 county population per thousand square miles. Information on annual temperature and population density is from the 1998 *Area Resource File*. State taxes on gasoline are obtained from *Facts and Figures on Government Finance*.

To account for the potential endogeneity of smoking, included among the instruments are cigarette taxes and clean indoor air laws. The price of cigarettes is taken from the Tax Burden on Tobacco (Orzechowski and Walker 2002). Clean indoor air laws are taken from the Centers for Disease Control and Prevention website (http://www.cdc.gov). The four indoor air laws pertaining to government workplaces, private workplaces, restaurants, and other places, are summed to form one variable.

Since structural models are difficult to estimate, we should be cautious with interpretation. Instruments, while passing tests for validity, might nevertheless be slightly weak. In addition, since non-random measurement error is likely to exist in the self-reported, potentially endogenous variables, instrumental variables methods will not necessarily eliminate this bias. I estimate ordinary least squares models, where I treat activity-adjusted caloric intake and smoking as exogenous, in addition to two-stage least squares models. I use activity-adjusted caloric intake as caloric intake and activity are likely to be strongly correlated, and proceed as follows. An alternative definition for activity that makes use of all the activity variables in NHANES can be created by combining the question "In your usual day, aside from recreation, how active are you?"

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with the question "Do you get much exercise in things you do for recreation?" These two questions are in NHANES I and NHANES II but not in NHANES III. For NHANES III, I use the question "Compared with most men/women your age, would you say that you are more active, less active, or about the same?" In addition, I create an analogous variable to the recreation variable in NHANES I and NHANES II by using activity intensity in NHANES III. If activity intensity is less than 50, the respondent is inactive in recreation; if between 50 and 149.9, moderately active; and if 150 or greater very active. Thus an alternative way to run the regression, rather than including caloric intake and activity level on the right-hand side, is to make use of the Harris-Benedict (1919) multipliers in order to adjust caloric intake for activity level. I classify multipliers for activity according to the following guidelines:

Sedentary: 1.2 (inactive in both recreation and work)

Lightly Active: 1.375 (inactive in one, active in the other)

Moderately Active: 1.55 (active in both, OR inactive in one, very active in the other)

Very Active: 1.725 (very active in one, active in the other)

Extra Active: 1.9 (very active in both).

I thus divide caloric intake by the above numbers according to activity category in both recreation and work.

V. Results

Table 3.1 shows definitions, means, and standard deviations of the variables. They are based on the sample of 28,252 that emerges when observations with missing values are deleted. NHANES sample weights are employed in all regressions, as well as state and year controls. To account for the aggregate nature of the instruments, standard errors

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allow for state/year clustering. Table 3.2 shows results for the whole sample and separately by gender. I see a consistent pattern in terms of the strong positive effect of caloric intake and the strong negative effect of smoking on BMI in ordinary least squares models. Older people, blacks, Hispanics, and married males are more likely to have a higher BMI, while those with a college education, and females with a higher household income are more likely to have a lower BMI. Two-stage least squares models show how the strong effects of caloric intake and smoking go away after controlling for their potential endogeneity, with the exception of caloric intake for females. This is notable, as it was the female who most frequently prepared meals at home. There is now less time and energy available for activities such as food preparation. Increases in hours worked and declines in real wage rates have increased the demand for inexpensive, prepared food, which has increased caloric intake. At the same time, work has become more sedentary. I also ran regressions where I only instrument for smoking using the cigarette tax and clean indoor air laws, and smoking consistently loses its effect on BMI when controlling for its endogeneity. This could be because smoking is correlated with other unhealthy behaviors, or because, if people are smoking to lose weight, then they might already be overweight to begin with.

Table 3.3 shows differences across race. Here smoking has negative, significant impacts on BMI for whites and Hispanics, but not for blacks, yet caloric intake has a positive and significant effect on BMI for blacks in two-stage least squares models. Black males have significantly lower BMIs than black females in both ordinary least squares and two-stage least squares models. Household income appears to lower BMI for whites but not for blacks or Hispanics.

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To see the direct effect of the instruments on the dependent variable, I also estimated reduced-form models for the whole sample; results are in Table 3.5. There are several things to note. Increases in the per capita number of restaurants are shown to increase BMI. At the mean, the effect translates to an increase of 0.123 kg/m^2 in average BMI for an additional restaurant. The food tax has a negative effect on BMI; people lower their caloric intake if food is not exempt from the general sales tax. Solutions to obesity such as taxing food might therefore cross one's mind, if indeed obesity not only is bad for one's health but imposes negative externalities on others, similarly to cigarettes. Yet as Philipson suggests, taxing food would be regressive, affecting the poor more than the rich (Mitka 2003). More densely populated areas have lower average BMIs. Urban areas encourage people to walk rather than take cars. The population density variable thus could have taken away the effect of the gas tax variable, as the food tax variable might have similarly done with the restaurant price. The cigarette tax and the indoor variables both hold the expected signs but are insignificant.

VI. Discussion

Obesity is an escalating problem in the United States. Caloric intake, which is habituating, and lack of physical activity, or a sedentary lifestyle, are prime contributors to this epidemic. The ready availability of inexpensive restaurants has not only caused people to consume more, but has made them less active – less likely to prepare food at home or travel further distances to obtain a healthy meal. The existence of fast food restaurants and the availability of inexpensive junk food facilitates caloric intake; man is conditioned to consume because, historically, this has been a means for survival.

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Pooled data from NHANES show caloric intake, activity level, and smoking to be important determinants of obesity. Reduced-form models reveal that the number of restaurants has a positive and significant effect in determining obesity. I find that increases in caloric intake increase female BMI, and that education and income in general lower it. Increases in the availability of restaurants and lowered food prices contribute to the epidemic.

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Table 3.1

Definitions, Means, and Standard Deviations of Variables

Variable	Definition	Mean and Standard Deviation
Body mass index	Weight in kilograms divided by height in meters squared	25.676 (5.274)
Caloric intake	Activity-adjusted kilocalories consumed in one day, based on 24-hour recall	1,533.030 (779.427)
Smoking	Dichotomous variable that equals 1 if respondent smokes, and 0 otherwise	0.353 (0.478)
Black non-Hispanic	Dichotomous variable that equals 1 if respondent is black but not Hispanic	0.105 (0.306)
Hispanic	Dichotomous variable that equals 1 if respondent is Hispanic	0.067 (0.250)
Other race	Dichotomous variable if respondent's race is other than white, black, or Hispanic	0.020 (0.139)
Male	Dichotomous variable that equals 1 if respondent is male	0.497 (0.500)
Elementary	Dichotomous variable that equals 1 if respondent completed 8 years of formal schooling	0.055 (0.229)
Some high school	Dichotomous variable that equals 1 if respondent completed at least 9 years but fewer than 12 years of formal schooling	0.164 (0.370)
High school graduate	Dichotomous variable that equals 1 if respondent completed exactly 12 years of formal schooling	0.353 (0.478)
Some college	Dichotomous variable that equals 1 if respondent completed at least 13 years but fewer than 16 years of formal schooling	0.181 (0.385)
College graduate	Dichotomous variable that equals 1 if respondent graduated from college	0.167 (0.373)
Married	Dichotomous variable that equals 1 if respondent is married	0.644 (0.479)
Divorced	Dichotomous variable that equals 1 if respondent is divorced or separated	0.091 (0.287)
Widowed	Dichotomous variable that equals 1 if respondent is widowed	0.055 (0.227)
Household income	Real household income in tens of thousands of 1982-84 dollars	2.990 (2.426)
Age	Age of respondent	41.791 (16.430)
Restaurants	Number of fast-food restaurants and full-service restaurants per ten thousand persons in respondent's state of residence	11.509 (2.259)

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Table 3.1 (continued)

Definitions, Means, and Standard Deviations of Variables

Variable	Definition	Mean and Standard Deviation
Restaurant price	Average real fast-food and full-service restaurant meal price in respondent's state of residence in 1982-84 dollars	6.235 (3.153)
Cigarette tax	Real state cigarette tax in 1982-84 cents	20.638 (8.985)
Death rate	Mortality from heart disease per 100,000 population, by age group and gender	269.633 (616.520)
Food tax	General state sales tax on food minus general state sales tax (negative if state exempts food)	-3.657 (3.371)
Annual temperature	Annual temperature in degrees Fahrenheit	54.829 (7.543)
Gas tax	Real state gasoline tax in 1982-84 cents per gallon	14.123 (3.356)
Population density	County population per thousand square miles	20.047 (62.666)
Private	Dichotomous variable that equals 1 if smoking is prohibited in private workplaces in respondent's state of residence	0.159 (0.366)
Government	Dichotomous variable that equals 1 if smoking is prohibited in state and local government workplaces in respondent's state of residence	0.203 (0.402)
Restaurant	Dichotomous variable that equals 1 if smoking is prohibited in restaurants in respondent's state of residence	0.304 (0.460)
Other	Dichotomous variable that equals 1 if smoking is prohibited in other public places such as elevators, public transportation, and theaters in respondent's state of residence	0.356 (0.479)
Indoor	Sum of indoor air law dichotomous variables (private+government+restaurant+other)	1.022 (1.400)

Standard deviation is reported in parentheses. Sample size is 28,252. NHANES sample weights are used in calculating the mean and standard deviation.

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Table 3.2

Body Mass Index Regressions, Whole Sample and By Gender, Persons 17 Years of Age and Older

Independent Variables	Whole Sample		Males		Females	
	(1) OLS	(2) 2SLS	(1) OLS	(2) 2SLS	(1) OLS	(2) 2SLS
Activity-adjusted	0.0004***	0.002	0.0003***	0.001	0.0005***	0.005*
caloric intake	(0.00007)	(0.002)	(0.00008)	(0.001)	(0.0001)	(0.003)
Smoking	-1.323***	-3.710	-1.251***	-2.400	-1.267***	-1.013
	(0.093)	(2.677)	(0.127)	(2.227)	(0.149)	(3.074)
Black	1.470***	1.636***	0.359**	0.578*	2.461***	2.697***
	(0.149)	(0.285)	(0.168)	(0.319)	(0.206)	(0.266)
Hispanic	0.700***	0.436	0.276	0.257	1.059***	0.973*
	(0.188)	(0.435)	(0.251)	(0.368)	(0.234)	(0.587)
Other race	-1.703***	-1.669***	-1.760***	-1.557***	-1.724***	-1.691**
	(0.345)	(0.459)	(0.338)	(0.396)	(0.546)	(0.731)
Male	0.343***	-0.561				
	(0.117)	(1.031)				
Elementary	0.037	0.036	0.159	0.176	-0.173	-0.549
	(0.179)	(0.269)	(0.219)	(0.235)	(0.337)	(0.419)
Some high school	0.123	0.144	0.176	0.099	-0.191	-0.443
	(0.180)	(0.333)	(0.195)	(0.248)	(0.305)	(0.430)
High school graduate	-0.047	-0.264	0.395**	0.244	-0.765***	-1.248***
	(0.184)	(0.313)	(0.198)	(0.287)	(0.285)	(0.390)
Some college	-0.520***	-0.925***	0.239	-0.029	-1.498***	-1.880***
	(0.181)	(0.301)	(0.203)	(0.366)	(0.309)	(0.473)
College graduate	-1.297***	-1.837***	-0.584***	-0.852*	-2.516***	-2.989***
	(0.191)	(0.450)	(0.192)	(0.469)	(0.316)	(0.680)
Married	0.490***	0.618***	0.903***	0.930***	0.163	0.330
	(0.150)	(0.170)	(0.160)	(0.194)	(0.244)	(0.332)
Divorced	0.097	0.442	0.130	0.311	-0.182	-0.098
	(0.184)	(0.404)	(0.250)	(0.472)	(0.252)	(0.501)
Widowed	0.705***	0.848**	0.773**	0.864	-0.087	0.046
	(0.237)	(0.404)	(0.342)	(0.624)	(0.307)	(0.465)
Household income	-0.207***	-0.305***	0.161*	0.098	-0.497***	-0.427**
	(0.071)	(0.114)	(0.093)	(0.141)	(0.121)	(0.171)
Household income	0.014*	0.023**	-0.017*	-0.011	0.038***	0.033*
squared	(0.008)	(0.010)	(0.009)	(0.012)	(0.014)	(0.018)
Age	0.351***	0.390***	0.305***	0.331***	0.378***	0.391***
	(0.018)	(0.041)	(0.022)	(0.045)	(0.025)	(0.039)
Age squared	-0.003***	-0.004***	-0.003***	-0.003***	-0.003***	-0.003***
	(0.0002)	(0.001)	(0.0002)	(0.001)	(0.0003)	(0.0005)

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Table 3.2 (continued)

Body Mass Index Regressions, Whole Sample and By Gender,
Persons 17 Years of Age and Older

Independent Variables	Whole Sample		Males		Females	
	(1) OLS	(2) 2SLS	(1) OLS	(2) 2SLS	(1) OLS	(2) 2SLS
Intercept	17.332*** (0.457)	14.969*** (2.385)	18.943*** (0.485)	16.457*** (3.191)	17.783*** (0.670)	9.238* (4.977)
Sample size	28,252	28,252	13,810	13,810	14,442	14,442

Note: All regressions include state and year dummies. All regressions employ NHANES sample weights.
Standard errors are in parentheses. Huber (1967) or robust standard errors on which they are based allow for state/year clustering.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 3.3

Body Mass Index Regressions, By Race,
Persons 17 Years of Age and Older

Independent Variables	White Non-Hispanic		Black Non-Hispanic		Hispanic	
	(1) OLS	(2) 2SLS	(1) OLS	(2) 2SLS	(1) OLS	(2) 2SLS
Activity-adjusted	0.0003***	0.002	0.001***	0.006*	0.0004***	-0.0004
caloric intake	(0.00009)	(0.002)	(0.0002)	(0.003)	(0.0001)	(0.001)
Smoking	-1.266***	-4.289*	-1.756***	-2.085	-1.137***	-5.193***
	(0.103)	(2.280)	(0.245)	(3.109)	(0.371)	(1.837)
Male	0.746***	0.091	-2.106***	-4.291***	-0.545**	0.544
	(0.130)	(1.088)	(0.204)	(1.479)	(0.274)	(0.786)
Elementary	0.232	0.281	0.101	-0.650	-0.966**	-0.880*
	(0.222)	(0.292)	(0.557)	(0.806)	(0.434)	(0.472)
Some high school	0.255	0.346	-0.018	-0.395	0.080	0.382
	(0.214)	(0.335)	(0.514)	(0.696)	(0.353)	(0.422)
High school graduate	0.127	-0.033	-0.554	-1.189*	-0.223	0.047
	(0.214)	(0.328)	(0.489)	(0.641)	(0.357)	(0.461)
Some college	-0.371*	-0.789**	-0.844	-1.536*	-0.900	-0.715
	(0.217)	(0.329)	(0.599)	(0.822)	(0.560)	(0.671)
College graduate	-1.176***	-1.810***	-1.128***	-1.577**	-2.016***	-2.293***
	(0.224)	(0.428)	(0.420)	(0.733)	(0.499)	(0.605)
Married	0.437**	0.655***	0.560*	0.226	0.500*	0.906**
	(0.172)	(0.199)	(0.329)	(0.431)	(0.296)	(0.349)
Divorced	-0.011	0.480	-0.532	-0.840*	1.035*	1.690***
	(0.227)	(0.379)	(0.338)	(0.433)	(0.583)	(0.641)
Widowed	0.560**	0.907**	0.960*	0.221	1.333	2.581**
	(0.260)	(0.391)	(0.520)	(0.681)	(0.849)	(1.102)
Household income	-0.263***	-0.391***	0.038	0.041	0.066	-0.050
	(0.076)	(0.105)	(0.164)	(0.237)	(0.202)	(0.238)
Household income	0.019**	0.030***	-0.007	0.0004	0.002	0.007
squared	(0.008)	(0.009)	(0.019)	(0.024)	(0.025)	(0.029)
Age	0.338***	0.377***	0.473***	0.509***	0.410***	0.440***
	(0.022)	(0.031)	(0.043)	(0.106)	(0.041)	(0.046)
Age squared	-0.003***	-0.004***	-0.005***	-0.004	-0.004***	-0.005***
	(0.0002)	(0.001)	(0.0005)	(0.001)	(0.0004)	(0.001)
Intercept	17.955***	15.807***	15.730***	11.248***	17.156***	16.433***
	(0.570)	(3.403)	(1.368)	(4.003)	(1.161)	(1.881)
Sample size	17,669	17,669	5,721	5,721	4,563	4,563

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Table 3.3 (continued)

Body Mass Index Regressions, By Race,
Persons 17 Years of Age and Older

Note: All regressions include state and year dummies. All regressions employ NHANES sample weights.
Standard errors are in parentheses. Huber (1967) or robust standard errors on which they are based allow for state/year clustering.
*Significant at the 10% level.
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***Significant at the 1% level.

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Table 3.4

Body Mass Index Regressions, Ordinary Least Squares
By Gender and Race, Persons 17 Years of Age and Older

Independent Variables	White Non-Hispanic		Black Non-Hispanic		Hispanic	
	Males	Females	Males	Females	Males	Females
Activity-adjusted	0.0003***	0.0004**	0.0005***	0.0008***	0.0002	0.0007***
caloric intake	(0.0001)	(0.0002)	(0.0001)	(0.0003)	(0.0001)	(0.0002)
Smoking	-1.2385***	-1.2400***	-1.3893***	-1.7970***	-1.1966***	-0.8148
	(0.1465)	(0.1549)	(0.2536)	(0.4596)	(0.2307)	(0.7218)
Sample size	8,688	8,981	2,658	3,063	2,308	2,255

Note: All regressions include controls for education, marital status, household income, age, geographic location, and year. All regressions employ NHANES sample weights.
Standard errors are in parentheses. Huber (1967) or robust standard errors on which they are based allow for state/year clustering.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 3.5

Effect of Instruments on Dependent Variable, Whole Sample

Independent Variables	Dependent Variable: BMI
Restaurants (full-service + fast food)	0.768*
	(0.433)
Restaurants squared	-0.028**
	(0.013)
Restaurant price	0.442
	(0.281)
Restaurant price squared	-0.007
	(0.013)
Death rate	-0.0002**
	(0.00008)
Food tax	-0.060*
	(0.035)
Annual temperature	-0.014
	(0.037)
Gas tax	0.022
	(0.032)
Population density	-0.001**
	(0.0008)
Cigarette tax	0.062
	(0.046)
Cigarette tax squared	-0.001
	(0.001)
Indoor	0.076
	(0.077)
Sample size	28,252

Note: All regressions include state and year dummies, as well as controls for race/ethnicity, age, gender, education, household income, and marital status. All regressions employ NHANES sample weights.
Standard errors are in parentheses. Huber (1967) or robust standard errors on which they are based allow for state/year clustering.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Chapter 4

Essay: Fast Food Advertising on Television and Its Influence on Childhood Obesity

I. Introduction

It is no longer normal to have a "normal" body weight, defined for adults as having a body mass index between 18.5 kg/m^2 and 24.9 kg/m^2 by the National Institutes of Health. According to the most recent National Health and Nutrition Examination Survey, which the Centers for Disease Control use to track changes in obesity in the United States over time, the majority of adults are overweight, and almost thirty percent are obese. For children aged 2 to 17, this figure stands at 14.07%, almost three times the percentage in the first National Health and Nutrition Examination Survey, conducted between 1971 and 1975.[20] While various studies have been done on adults, it is important to turn our attention to children. Overweight children are likely to grow into overweight adults, and lifestyle habits are formed in childhood. Severely obese children and adolescents have a lower health-related quality of life (Schwimmer et al. 2003). Aggregate medical spending for the United States that is attributable to obesity accounted for 9.1% of total annual medical expenditures in 1998, as high as $78.5 billion (Finkelstein et al. 2003). The problem is not purely a genetic one, since the gene pool cannot change that rapidly over three decades. Since the environment is clearly to blame, the problem has been labeled an epidemic and action should take place. This first and foremost comes in the form of finding causes of the rise in obesity over time.

Children and adolescents are increasing engaging in sedentary behavior, spending less time exercising outdoors and more time watching television and being exposed to

[20] Percentages are based on my calculations using the National Health and Nutrition Examination Surveys. Survey weights are employed in all computations. Refer to Table 4.1.

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fast food advertising on television. A study using the Continuing Survey of Food Intake by Individuals produced evidence that fast food consumption among children and adolescents in the United States had an adverse effect on dietary quality, which could in turn increase risk for obesity. Television watching may influence obesity both by reducing activity and by exposing children to fast-food advertising. The incidence of obesity is highest among children who watch four or more hours of television a day and lowest among children watching an hour or less a day (Crespo et al. 2001). Around 1950, only 2 percent of households in the United States had television sets; by the early 1990s, 98 percent of households owned at least one, and over 60% had cable television (Huston et al. 1992; Donnerstein et al. 1994). Healthy People 2010 suggests that children and adolescents not watch more than two hours of television per day (USDHHS 2000). In addition, a recent study has shown that a third of children eat fast food on a daily basis (Bowman et al. 2004). Isolating the effect that fast food advertising on television has on children and adolescents is a key concern. This is a particularly important topic as the Bush administration recently argued that no one has proven that advertising causes obesity, after the World Health Organization proposed that countries be urged to limit advertisements, especially those directed at children, that encourage unhealthy diets.

II. Background and Literature Review

Obesity puts children at risk for a range of health problems. The prevalence of type II diabetes in children, originally termed adult onset diabetes, went from 4 percent in 1982 to 16 percent in 1994 (Squires 1998). In adults the increased prevalence of restaurants per capita seems to have been a major contributor to the increase in obesity over time.

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Among women, television watching, independent of exercise levels, was associated with a significantly increased risk of obesity and type II diabetes (Hu et al. 2003).

Dietz and Gortmaker (1985) found that for every additional hour of television watched, the incidence of obesity increased by 2 percent. Intervention programs that limit the amount of time of television watched by children have been recommended, not only for school-aged children but also for preschool children (Dennison et al. 2004), as viewing patterns are shaped during the preschool years.

Anderson, Butcher, and Levine (2003) focus on children and find that maternal employment has an effect on obesity in children. They specifically find that it is not that the mother is in the labor force that matters but rather the long hours worked, so the more hours worked by the mother, the more likely the child is to be obese. The role that mothers play in their children's development is further highlighted by Burdette et al. (2003), who provide evidence that maternal obesity and depressive symptoms in mothers are associated with increased television watching by their children.

While watching television and being exposed to fast food advertising on television, children are likely to develop unhealthy lifestyle habits that are likely to carry over into adulthood. The sedentary activity of watching television further encourages one to consume unhealthy foods. Television watching and soft drink consumption have been associated with obesity in sixth- and seventh-grade students (Giammattei et al. 2003). There has been consistent evidence that television watching in children and adolescents is associated with increased risks of children being overweight (Andersen et al. 1998). Children are further encouraged to consume junk food at schools, where one can see the extensive effect that fast food and soft drink companies have. Aside from

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what is served for school lunches, there are very few laws governing what food is sold in schools competitively.

III. Methodology

This empirical study attempts to isolate the effect of fast food advertising on television on obesity in children. Dependent variables are body mass index, overweight status, and obese status. Body mass index is measured as weight in kilograms divided by height in meters squared, and is the standard used by the National Institutes of Health in tracking obesity over time.[21] For children and adolescents, I define being overweight as having a body mass index at or above the 85th percentile, based on age- and gender-specific growth charts created by the Centers for Disease Control and Prevention. I define obese children and adolescents as those having a body mass index at or above the 95th percentile based on the Centers for Disease Control growth charts. While the term "obese" is generally not used for children and adolescents, I will use this term to keep it consistent with the analogous term for adults. (For children and adolescents, the terms "at risk of overweight" and "overweight" are in general used instead of "overweight" and "obese," respectively.)

Adolescents 12 to 18 years of age are included from the 1997 National Longitudinal Survey of Youth data set. Children 6 to 14 years of age are included from the 1979 National Longitudinal Survey of Youth Child and Young Adult file. The analysis is done separately by gender. The longitudinal nature of the data sets allow for the estimation of fixed effects models, which take into account potential unobserved heterogeneity. The main independent variables are time watching television, and the

[21] Alternatively, one may calculate body mass index using weight in pounds divided by height in inches squared, multiplied by a factor of 704.5.

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interaction of time watching television with fast food advertising expenditures. Right-hand side variables also include age, household income, dummy variables for whether the mother is overweight or obese, and state and year fixed effects. County annual temperature and state food at home price are also included on the right-hand side. Physical activity is important in lowering rates of obesity. Healthy People 2010 recommends 30 minutes of physical activity per day for adolescents as well as for adults (USDHHS 2000). Since there are no good measures of physical activity in the NLSY, I use annual temperature as a proxy for physical activity. I include food at home price as reducing the price of healthy food is likely to result in an increase in its consumption (French 2003).

My main regression is:

$$Y_{it} = X_{it}\beta + \varepsilon_{it},$$

where *i* represents the individual and *t* denotes year. *Y* represents either body mass index or obese, and *X* is the vector of exogenous variables. In ordinary least squares (OLS), the panel structure of the data set is ignored and the stacked model is estimated. In a fixed-effect model,

$$\varepsilon_{it} = \alpha_i + \eta_{it},$$

where α_i is the individual effect. With fixed effects we assume that the individual effect is correlated with *X*. Differencing between time periods removes unobserved correlated effects α_i (and yet also removes observed variables that do not vary over time).

IV. Data

The micro-level data set that I use for adolescents aged 12 to 18 is the National Longitudinal Survey of Youth 1997. The National Longitudinal Survey of Youth 1997

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(hereafter NLSY97) consists of a nationally representative sample of approximately 9,000 youths who were 12 to 16 years old as of December 31, 1996. The survey has collected extensive information about youths' labor market behavior and educational experiences over time, as well as information on television watching. Round 1 of the NLSY97, which took place in 1997, contains a parent questionnaire that generates information about the youths' family background and history.

The micro-level data set that I use for children aged 6 to 14 is the National Longitudinal Survey of Youth 1979 Child and Young Adult file. The National Longitudinal Survey of Youth 1979 is a nationally representative sample of 12,686 young men and women who were 14-22 years old when they were first surveyed in 1979. In 1986, a separate survey of all children born to female respondents began, making up the Child and Young Adult File (hereafter NLSY79).

Fast food advertising data is obtained from Competitive Media Reporting (CMR), the largest provider of advertising tracking services in the United States. This has exposure information and dollar expenditures for a wide array of fast food chains in the United States from 1996 to 1999.[22] Competitive Media Reporting was formed in 1992 by combining several advertising tracking and broadcast proof-of-performance companies.

Annual temperature pertains to the mean 1976 temperature in the county of residence, and is obtained from the 1998 *Area Resource File*. Real food at home price (in

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[22] The corporations I chose for this analysis that I believed best reflected the fast food industry were: A&W Restaurants Inc, AFC Enterprises, Allied Domecq Plc, Arthur Treachers Inc, Carrols Corp, Chester Fried Chicken Restaurants, Chick-Fil-A Inc, Cici Enterprises Inc, Cke Restaurants Inc, Culver Franchising System Inc, Diageo Plc, Dominos Pizza Inc, Fatboys Franchise Systems Inc, Foodmaker Inc, Galardi Group, Hungry Howies Pizza & Subs Inc, Ich Corp, In-N-Out Burgers Inc, Inno-Pacific Holdings Inc, Krispy Kreme Doughnut Corp, Krystal Co, Leeann Chin, Little Caesars Enterprises Inc, Long John Silvers Inc, McDonalds Corp, Panda Express, Papa Ginos Inc, Papa Johns Intl Inc, Quality Dining Inc, Ranch 1, Rax Restaurants Inc, Showbiz Pizza Time Inc, Sizzler Intl Inc, Sonic Corp, Speedy Burgers Inc, TCBY

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1998 dollars) is based on state averages obtained from the American Chamber of Commerce Researchers Association (ACCRA). The food at home price was constructed from thirteen ACCRA grocery food prices, weighted by the average expenditure shares of these items as reported by ACCRA. These thirteen items were bacon, bananas, bread, eggs, chicken, ground beef, milk, lettuce, margarine, parmesan cheese, potatoes, steak, and tuna.

V. Results

Table 4.2 shows means and standard deviations for the NLSY97 and NLSY79 data sets. They have sample sizes of 7,404 for the NLSY97 data set and 6,425 for the NLSY79 data set after missing observations for child's body mass index, TV watching, advertising, mother's overweight and/or obese status, family income, food at home price, and annual temperature are deleted. In addition, the sample was restricted to those that have a body mass index not less than 11 kg/m^2 and not greater than 140 kg/m^2.[23] Tables 4.3 and 4.4 respectively show results where the child's body mass index and overweight status are dependent variables for adolescents aged 12 to 18 in the NLSY97. Tables 4.5 and 4.6 respectively show results where the child's body mass index and overweight status are dependent variables for children aged 6 to 14 in the NLSY79. Years used for the NLSY97 are 1997, 1998, and 1999. Years used for the NLSY79 are 1996, 1998, and 2000.[24] Identical analyses could not be done using both data sets because of limits on

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Enterprises Inc, Triarc Cos Inc, Tricon Global Restaurants Inc, Wendys Intl Inc, Whataburger Inc, and White Castle System Inc.

[23] For the NLSY97, since I am dealing with adolescents and self-reported values, adjusted body mass index was used. This is based on a correction that uses the National Health and Nutrition Examination Survey, which contains actual as well as self-reported weight and height. Actual weight was regressed on self-reported weight, its square, age, and age squared for adolescents aged 12 to 17. Similar regressions were done for height, by gender and race. Coefficients obtained were used to correct self-reported body mass index. Regression results with and without this correction were very similar.

[24] Since the advertising data obtained ends in 1999, 1999 advertising data was used for 2000 in NLSY79.

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responses for the television watching variable. Divergent results between the two samples are expected, as research has shown that adolescents respond differently to advertisements than do children (Ward 1976). Children behave more impulsively towards advertising and attempt to make "purchases" through parental influence, whereas adolescents can carry more cynical attitudes towards commercials and often take on consumer roles.

Whether the mother was overweight or obese helps to partially capture the genetic component that determines the child's body mass index. State and year dummies are also included in all regressions. Results are stratified by gender. The *OLS* column shows ordinary least squares results. The *Fixed Effects* column takes advantage of the panel nature of the data sets in order to analyze the effect of fast food advertising using individual fixed effects models.[25] The *TV Time excluded* column shows results where the television watching variable is not used at all. This enables us to see the direct effect of dollar expenditures for fast food advertising, which is the focus of this paper, on child's body mass index.[26]

In OLS regressions, we consistently see that exposure to fast food advertising has a positive and significant effect for adolescent females in both body mass index and overweight regressions. The effect remains positive for both male and female children.

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[25] The television watching variable is only available in 1997 for adolescents. Since this variable does not vary with time, it drops out of individual fixed effects models.

[26] For these regressions, instrumental variables models were also run where price of advertising (dollars per exposure time) was used as an instrument for advertising. Price of advertising is a good instrument for advertising and has been used in the past (see, for example, Saffer 1997). Results for these models were very similar to the OLS results. (Wu-Hausman tests for the correlation between the error terms in the advertising equation and in the body mass index equation reveal that advertising is exogenous for both females and males in both data sets. This is done by regressing advertising on all exogenous variables, saving the predicted value, and then including the predicted value in the original equation of interest – the body mass index equation. If the predicted value of advertising is insignificant, advertising is believed to be exogenous.)

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There is a surprisingly negative (but insignificant) effect of the interaction variable on adolescent males. Fixed effects models are consistent and show a positive and significant effect of the interaction variable on the probability of being overweight for male children. Elasticities in Table 4.7 are based on OLS regressions and are taken at mean values by gender for body mass index, overweight, and the TV/advertising interaction.

Annual temperature consistently has a negative effect on body mass index and the probability of being overweight in OLS models. Yet for adolescent females, this effect is positive (although insignificant). This might reflect that adolescent females are less inclined to participate in outdoor activities due to the weather, and might even prefer to stay indoors when it is warmer. Blacks and Hispanics are more likely to have higher body mass indexes and be overweight, as are those with overweight or obese mothers, reflecting the genetic component.

VI. Discussion

Limiting fast food advertising on television might be drastic, but knowing what effect it has on childhood obesity in the first place is an important step in knowing what could be done to reduce obesity. It is estimated that children now watch an average of more than 40,000 television advertisements a year, a 100 percent increase since that late 1970s (Kunkel 2001). In addition, the majority of these advertisements are ones for food, whether the food be candy, cereal, or fast food. The Federal Communications Commission and the Federal Trade Commission, pressed by ACT (Action for Children's Television) in the past has made attempts to limit commercials during hours of children's programming. They did, however, face angry opposition by candy, cereal, toy, and advertising industries (Krasnow et al. 1982). Parental control might thus be more

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effective. Preliminary results in this paper show that fast food advertising can possibly affect children's and adolescents' body mass indexes and probabilities of being overweight, particularly for adolescent females.

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Table 4.1

Trends in Body Mass Index and the Percentage Overweight,
Persons 2 to 17 Years of Age[a]

Survey	Period	Body Mass Index[b]	Percentage Overweight[c]
NHES II-III	1963-1970	18.53[d]	4.41[d]
NHANES I	1971-1975	18.16	4.81
NHANES II	1976-1980	18.36	5.01
NHANES III	1988-1994	18.86	10.35
NHANES 99	1999-2000	19.26	14.07

[a]The surveys are as follows: National Health Examination Survey II and III (NHES II-III), National Health and Nutrition Examination Survey I (NHANES I), National Health and Nutrition Examination Survey II (NHANES II), National Health and Nutrition Examination Survey III (NHANES III), and National Health and Nutrition Examination Survey 1999-2000 (NHANES 99). Survey weights are employed in all computations.

[b]Weight in kilograms divided by height in meters squared. Actual weights and heights are used in calculation.

[c]Percentage with body mass index equal to or greater than the 95th percentile based on Centers for Disease Control and Prevention growth charts. See http://www.cdc.gov/growthcharts.

[d]Data pertain to 6-17 year olds rather than to 2-17 year olds.

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Table 4.2

Definitions, Means, and Standard Deviations of Variables

Variable	**Definition**	NLSY97 Mean (Standard Deviation)	NLSY79 Mean (Standard Deviation)
Body mass index	Weight in kilograms divided by height in meters squared	22.425 (4.553)	19.349 (5.185)
Overweight	Dichotomous variable that equals 1 if body mass index is equal to or greater than the 95th percentile	0.120 (0.325)	0.163 (0.369)
TV Time (TV)	Time spent by child watching television (in minutes per week)	1212.035 (934.100)	1909.964 (1869.647)
Dllr	Total real dollars spent for fast food advertising (in tens of thousands of dollars)	0.00009 (0.00009)	0.00008 (0.00009)
Annual temperature	Average annual temperature in county	56.515 (7.157)	56.492 (7.561)
Food at home price	Real ACCRA food at home price, state average, in 1982-84 dollars	2.034 (0.276)	2.019 (0.231)
Male	Dichotomous variable that equals 1 if respondent is male	0.525 (0.499)	0.508 (0.500)
Black non-Hispanic	Dichotomous variable that equals 1 if respondent is black but not Hispanic	0.251 (0.434)	0.279 (0.449)
Hispanic	Dichotomous variable that equals 1 if respondent is Hispanic	0.197 (0.398)	0.192 (0.394)
Other race	Dichotomous variable if respondent's race is other than white, black, or Hispanic	0.009 (0.096)	
Age	Age of respondent	14.755 (1.399)	9.897 (2.412)
Family income	Real household income in tens of thousands of 1982-84 dollars	3.637 (4.552)	5.824 (8.734)
Mother overweight	Dichotomous variable that equals 1 if mother's body mass index is equal to or greater than 25 kg/m^2	0.526 (0.499)	0.566 (0.496)
Mother obese	Dichotomous variable that equals 1 if mother's body mass index is equal to or greater than 30 kg/m^2	0.228 (0.420)	0.282 (0.450)
Yr98	Dichotomous variable that equals 1 if year=1998	0.329 (0.470)	0.363 (0.481)
Yr99	Dichotomous variable that equals 1 if year=1999	0.334 (0.472)	
Yr00	Dichotomous variable that equals 1 if year=2000		0.268 (0.443)

Standard deviation is reported in parentheses. Sample size is 7,404 for the NLSY 1997, and 6,425 for the NLSY 1979 Mother-Child data set.

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Table 4.3

Results using the NLSY97, Ages 12 to 18
Dependent Variable: Body Mass Index

	Females			*Males*		
	OLS	**Fixed Effects**	**TV Time excluded**	**OLS**	**Fixed Effects**	**TV Time excluded**
TV Time	0.0002			0.0006***		
	(0.89)			(3.36)		
TV*Dllr	2.5673**	1.7675	2484.9190	-0.0302	-1.6426	2853.2120*
	(2.29)	(0.95)	(1.37)	(-0.04)	(-1.28)	(1.70)
Annual temperature	0.0352	-0.0902	0.0448	-0.0375	0.1401	-0.0469
	(0.97)	(-0.69)	(1.24)	(-1.12)	(1.24)	(-1.32)
Food at home price	-0.3783	-0.5194	-0.2897	-0.7675	0.3088	-0.7832
	(-0.20)	(-0.42)	(-0.15)	(-0.52)	(0.26)	(-0.53)
Age	0.7631***	0.1921	0.7756***	0.4737***	-0.1195	0.4939***
	(6.20)	(1.64)	(6.31)	(4.43)	(-1.09)	(4.33)
Hispanic	0.7476***		0.8587***	0.8652**		0.8608**
	(2.78)		(2.98)	(2.52)		(2.40)
Black	1.4700***		1.6379***	0.2780		0.5341*
	(4.13)		(4.54)	(0.95)		(1.81)
Other	-0.6704		-0.4937	1.6875**		1.5523*
	(-0.86)		(-0.66)	(1.98)		(1.82)
Family income	-0.0245	0.2166	-0.0272	-0.0203	1.2718***	-0.0280
	(-0.90)	(0.50)	(-0.99)	(-1.06)	(3.16)	(-1.55)
Mother overweight	0.9107***		0.9777***	1.1180***		1.1355***
	(3.72)		(3.97)	(5.15)		(5.18)
Mother obese	2.5103***		2.5650***	1.4118***		1.4525***
	(6.38)		(6.72)	(3.98)		(3.98)
Year98	-0.3624*	0.6642***	-0.3764*	0.4783**	1.5519***	0.4156**
	(-1.67)	(3.09)	(-1.71)	(2.46)	(7.80)	(1.99)
Year99	-0.3070	1.1589***	-0.3369	0.8598***	2.5740***	0.7701**
	(-0.86)	(3.58)	(-0.94)	(3.06)	(8.60)	(2.55)
Observations	3,516	3,516	3,516	3,888	3,888	3,888

Controls for geographic location are included in all regressions. Regressions are clustered by county. T-ratios are reported in parentheses.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 4.4

Results using the NLSY97, Ages 12 to 18
Dependent Variable: Overweight

	Females			*Males*		
	OLS	**Fixed Effects**	**TV Time excluded**	**OLS**	**Fixed Effects**	**TV Time excluded**
TV Time	0.0000007			0.00004**		
	(0.05)			(2.58)		
TV*Dllr	0.1802**	0.0247	107.9913	-0.0499	-0.3785***	111.6365
	(2.28)	(0.13)	(0.84)	(-0.77)	(-2.63)	(0.77)
Annual temperature	0.0029	0.0074	0.0040*	-0.0026	-0.0022	-0.0033
	(1.37)	(0.57)	(1.74)	(-0.89)	(-0.18)	(-1.13)
Food at home price	0.0284	0.0746	0.0324	-0.0483	0.0502	-0.0489
	(0.21)	(0.60)	(0.24)	(-0.29)	(0.37)	(-0.29)
Age	0.0024	-0.0046	0.0032	-0.0088	-0.0029	-0.0078
	(0.29)	(-0.40)	(0.39)	(-1.14)	(-0.24)	(-0.97)
Hispanic	0.0185		0.0246	0.0855***		0.0845***
	(0.92)		(1.31)	(3.19)		(3.08)
Black	0.0725***		0.0786***	0.0246		0.0381*
	(3.55)		(3.84)	(1.12)		(1.70)
Other	-0.0677***		-0.0588***	0.0907		0.0841
	(-2.92)		(-2.79)	(1.20)		(1.11)
Family income	-0.0019	0.0592	-0.0020	-0.0009	0.0098	-0.0013
	(-1.37)	(1.38)	(-1.48)	(-0.57)	(0.22)	(-0.91)
Mother overweight	0.0315**		0.0352**	0.0453***		0.0463***
	(2.12)		(2.45)	(2.64)		(2.72)
Mother obese	0.1494***		0.1513***	0.1106***		0.1127***
	(6.30)		(6.57)	(4.70)		(4.76)
Year98	-0.0079	0.0112	-0.0082	0.0021	0.0001	-0.0015
	(-0.48)	(0.52)	(-0.49)	(0.15)	(0.01)	(-0.10)
Year99	-0.0023	0.0195	-0.0033	0.0204	0.0118	0.0154
	(-0.11)	(0.61)	(-0.15)	(1.02)	(0.35)	(0.73)
Observations	3,516	3,516	3,516	3,888	3,888	3,888

Controls for geographic location are included in all regressions. Regressions are clustered by county. T-ratios are reported in parentheses.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 4.5

Results using the NLSY79, Ages 6 to 14
Dependent Variable: Body Mass Index

	Females			*Males*		
	OLS	**Fixed Effects**	**TV Time excluded**	**OLS**	**Fixed Effects**	**TV Time excluded**
TV Time	0.00005	-0.0001		-0.00001	-0.0001	
	(0.86)	(-1.55)		(-0.16)	(-1.29)	
TV*Dllr	0.1613	0.3321	-2225.7860	0.2262	1.1312	-71.9018
	(0.46)	(0.56)	(-1.24)	(0.51)	(1.57)	(-0.04)
Annual temperature	-0.0913*	-0.6029**	-0.0654	-0.0395	0.1815	-0.0354
	(-1.69)	(-2.41)	(-1.16)	(-0.95)	(0.55)	(-0.81)
Food at home price	1.2499	5.5546***	1.2709	1.1907	2.6088	1.2135
	(0.71)	(3.05)	(0.71)	(0.33)	(1.23)	(0.34)
Age	0.7479***	0.3373	0.7503***	0.7022***	-0.1125	0.7014***
	(19.77)	(1.09)	(19.64)	(17.87)	(-0.30)	(17.93)
Hispanic	0.8695*		0.9359**	0.8400**		0.8513**
	(1.87)		(2.01)	(2.47)		(2.55)
Black	1.2916***		1.3580***	0.3482		0.3580
	(3.94)		(4.36)	(1.20)		(1.26)
Family income	-0.0190**	0.0062	-0.0197***	0.0002	0.0103	0.0002
	(-2.59)	(0.53)	(-2.67)	(0.03)	(0.80)	(0.03)
Mother overweight	1.1600***	0.5680*	1.1716***	0.9279***	0.2481	0.9280***
	(4.15)	(1.69)	(4.22)	(4.56)	(0.62)	(4.57)
Mother obese	1.4693***	-0.2675	1.4685***	1.3126***	-0.4832	1.3101***
	(4.61)	(-0.80)	(4.55)	(5.59)	(-1.15)	(5.57)
Year98	-0.0667	1.1022*	-0.0486	0.3853**	1.9096***	0.3957**
	(-0.45)	(1.76)	(-0.32)	(2.51)	(2.57)	(2.60)
Year00	0.6981***	2.8403**	0.6980***	1.0245***	4.7322***	1.0311***
	(4.48)	(2.22)	(4.53)	(4.11)	(3.12)	(4.09)
Observations	3,163	3,163	3,163	3,262	3,262	3,262

Controls for geographic location are included in all regressions. Regressions are clustered by county. T-ratios are reported in parentheses.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 4.6

Results using the NLSY79, Ages 6 to 14
Dependent Variable: Overweight

	Females			*Males*		
	OLS	**Fixed Effects**	**TV Time excluded**	**OLS**	**Fixed Effects**	**TV Time excluded**
TV Time	0.000004	-0.000009		-0.000002	-0.000007	
	(0.85)	(-1.51)		(-0.47)	(-1.33)	
TV*Dllr	0.0152	0.0509	-187.5945	0.0242	0.0912*	97.6353
	(0.65)	(0.97)	(-1.51)	(0.67)	(1.77)	(0.89)
Annual temperature	-0.0040	-0.0204	-0.0018	-0.0039	0.0073	-0.0044
	(-0.93)	(-0.91)	(-0.44)	(-1.16)	(0.31)	(-1.33)
Food at home price	0.1212	0.2291	0.1232	-0.0716	0.0046	-0.0734
	(0.95)	(1.41)	(0.97)	(-0.41)	(0.03)	(-0.42)
Age	-0.0047	-0.0279	-0.0045	-0.0015	0.0288	-0.0015
	(-1.66)	(-1.01)	(-1.56)	(-0.48)	(1.10)	(-0.48)
Hispanic	0.0675*		0.0731**	0.0610**		0.0609**
	(1.90)		(2.05)	(2.04)		(2.05)
Black	0.1002***		0.1057***	0.0091		0.0085
	(4.04)		(4.54)	(0.40)		(0.37)
Family income	-0.0014**	-0.0006	-0.0014***	-0.0004	0.0006	-0.0004
	(-2.59)	(-0.57)	(-2.64)	(-0.68)	(0.68)	(-0.69)
Mother overweight	0.0539***	-0.0038	0.0549***	0.0779***	-0.0218	0.0784***
	(2.88)	(-0.13)	(2.99)	(4.36)	(-0.76)	(4.39)
Mother obese	0.0947***	0.0009	0.0946***	0.1033***	-0.0524*	0.1031
	(3.82)	(0.03)	(3.81)	(4.72)	(-1.74)	(4.72)
Year98	-0.0163	0.0465	-0.0146	0.0106	-0.0529	0.0104
	(-1.40)	(0.83)	(-1.34)	(0.86)	(-1.00)	(0.86)
Year00	0.0125	0.1391	0.0126	0.0450***	-0.0447	0.0445***
	(0.90)	(1.22)	(0.97)	(2.75)	(-0.41)	(2.65)
Observations	3,163	3,163	3,163	3,262	3,262	3,262

Controls for geographic location are included in all regressions. Regressions are clustered by county. T-ratios are reported in parentheses.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 4.7

Elasticities for Body Mass Index and Overweight with Respect to Fast Food Advertising Watched on Television for Adolescents (NLSY97) and Children (NLSY79)

Body Mass Index	*Females*		*Males*	
	Adolescents	**Children**	**Adolescents**	**Children**
TV*Dllr	0.0121	0.0012	-0.0002	0.0017
Overweight	*Females*		*Males*	
	Adolescents	**Children**	**Adolescents**	**Children**
TV*Dllr	0.1845	0.0142	-0.0431	0.0202

Computed at sample means.

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Chapter 5

Social and Labor Market Consequences of Being Obese

"*What planet are you living on?*"
– Said by a friend, after I suggested that obese people were treated as equals in society

Discrimination against overweight and obese people is prevalent, particularly for females, who are often judged in both social and business situations by their beauty. Since measures for beauty are often subjective, I shall use body mass index as a proxy for beauty, which has been previously used (see, for example, Averett and Korenman 1996).[27]

Marriage Markets and Obesity: How Likely Are Heavy People to Tie the Knot?

Medical studies have established that heavier people suffer more illness; in addition, there are labor market consequences to obesity, as we shall see later on. Obese people tend to hold jobs that are not as high-paying in addition to being discriminated against in the labor market. Fewer studies, however, have established social consequences of obesity. Cawley (2001) has presented evidence to show that overweight teenagers date less.

Using the National Longitudinal Survey of Youth 1979, I estimate hazard models for the probability of marriage. The years I use are 1986, 1988, 1990, 1992, 1994, 1996, 1998, and 2000. My main variable of interest on the right-hand side is body mass index (or the probability of being obese). While the usual cutoff for obese is used (namely, one with a body mass index of 30 kg/m^2 or greater), we must keep in mind that the social

[27] Body mass index is not always used as a measure for beauty. In *Business Success and Businesses' Beauty Capital*, Gerard A. Pfann et al. use a sample of advertising firms, and the executives' beauty is judged based on photographs. The authors find that beauty has a great impact on the firms' revenues, more so than on the executives' actual wages. Hamermesh and Biddle (1994) use interviewers' ratings of

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stigma associated with having a certain body mass index comes from cutoffs that society creates through images, and not necessarily medically established ones. There are also differences across gender and race. While my sample sizes for gender/race subsamples are a bit small to draw conclusions across race, my data reveal that obese white females, and possibly obese Hispanic males, are less likely to marry in a given period, given that they were single during the previous period.

I control for race, education, employment status, age, income, whether or not the respondent has at least one child (for females), and geographic location. I do the analysis separately by gender, and also by gender and race.

The Weibull distribution is a popular choice for parametric hazard models (see Greene 2003) and will be used here.[28] The hazard function is thus specified as:

$$\lambda(t) = \lambda p(\lambda t)^{p-1},$$

where t is time and p is a scale parameter. If p is greater than 1, positive duration dependence is exhibited, which means that marriage is more likely to occur at time t given that the individual has lasted being single up until time t. (Therefore $\partial\lambda / \partial t > 0$.) Additionally, if the value of p is greater than 2, we see time increasing in the hazard function at an increasing rate. In this case, we see positive duration dependence where the second derivative is also positive.[29] Therefore, the longer a person has been single, the more likely that person is to leave that state and get married.

Table 5.1 shows the influence of certain variables on the hazard function of marriage. Hazard ratios are reported for ease of interpretation. For example, a value for

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respondents' physical appearance (which of course can be very subjective), and find that good-looking people earn more. They find that this impact is independent of occupation for the most part.

[28] Several different distributions were experimented with, and the Weibull distribution seemed to be the best fit after graphing Cox-Snell residuals. Nevertheless, all distributions gave similar results.

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females of 0.9417 for obese means that females who are obese are 5.83% less likely to get married the following year, while a value of 1.0079 for males means that males who are obese are 0.79% more likely to get married (although the latter result is insignificant). We therefore see that body mass index and being obese matters for females but not for males. In addition, females who work are likely to delay marriage, while the very opposite is true for males who work.

[29] The values of p exceed 1000 in all runs.

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Table 5.1

Effects of Selected Variables on Hazard Function of Marriage, by Gender

	Females		*Males*	
	(1)	(2)	(3)	(4)
BMI	0.9950**		1.0029	
	(-2.42)		(1.01)	
Obese		0.9417*		1.0079
		(-1.94)		(0.26)
Work	0.9076***	0.9083***	1.4107***	1.4117***
	(-3.24)	(-3.22)	(7.19)	(7.20)
Black	0.5066***	0.5041***	0.6686***	0.6700***
	(-17.47)	(-17.66)	(-10.58)	(-10.51)
Hispanic	0.8443***	0.8411***	0.9431	0.9470
	(-4.28)	(-4.39)	(-1.45)	(-1.35)
Age	0.7615***	0.7613***	0.7768***	0.7770***
	(-44.96)	(-45.00)	(-41.67)	(-41.65)
Some high school	0.8170***	0.8185***	0.8094***	0.8087***
	(-2.96)	(-2.93)	(-3.40)	(-3.41)
High school	0.9747	0.9757	0.9474	0.9483
	(-0.58)	(-0.56)	(-1.28)	(-1.26)
Some college	1.0573	1.0590	1.0291	1.0297
	(1.21)	(1.24)	(0.62)	(0.63)
College	1.1205**	1.1263**	1.0192	1.0184
	(2.26)	(2.37)	(0.38)	(0.37)
Observations	10,159	10,159	9,733	9,733

Hazard ratios reported. Controls for income, whether or not the respondent has at least one child (for females), and geographic location are also included in all regressions. T-ratios are reported in parentheses.

*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 5.2

Effect of Body Mass Index and Obese on Hazard Function of Marriage,
By Gender and Race

	Females			*Males*		
	White	**Black**	**Hispanic**	**White**	**Black**	**Hispanic**
BMI	0.9933** (-2.52)	0.9989 (-0.24)	0.9952 (-0.91)	1.0026 (0.66)	1.0088 (1.34)	0.9901 (-1.56)
Obese	0.9193** (-2.02)	0.9427 (-0.89)	1.0413 (0.58)	1.0193 (0.46)	1.0604 (0.88)	0.8547** (-2.38)
Observations	5,275	2,981	1,903	5,250	2,640	1,843

Controls for employment status, age, education, income, whether or not the respondent has at least one child (for females), and geographic location are also included in all regressions.
T-ratios are reported in parentheses.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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The Direct Relationship Between Income and Beauty

When analyzing the effect of body mass index on income, one needs to recognize the policy implications that result from finding significant results. How can we measure this discrimination, if we find that discrimination truly exists? In line with previous studies, but using a different data set (namely, NHANES III, the Third National Health and Nutrition Examination Survey), I analyze the effect of body mass index on income and find a negative and significant effect for all females.[30] For males, there is a positive and significant effect. This is not a light result; it suggests that it is better for females to have less weight on them and for males to have more weight on them, if they want to earn more. One severe shortcoming of using the NHANES data set for this exercise is that only family income is reported rather than individual income. Effects through marriage markets are thus not obtained.

The main study that best mirrors this exercise is *The Economic Reality of the Beauty Myth*, by Susan Averett and Sanders Korenman. In it, the authors use a sample of 23- to 31-year-olds to analyze the effects of body mass index on income, marital status, and hourly pay differentials. They are also able to control for family background by comparing same-sex siblings. The data set that they use, the National Longitudinal Survey of Youth 1979, is a comprehensive panel data set. They take data from the year 1988. Averett and Korenman also use previous body mass index, from 1981, in order to control for possible endogeneity, as income might also influence body mass index. Although I have a cross-sectional data set, there is a question "How much did you weigh ten years ago?" in the NHANES III data set. I assume height to be the same, as this does

[30] I only report results for females here.

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not tend to change for adults. (One might argue that this might not be entirely true for the lower end of the age range. This would mean that we would be looking at body mass indexes for 25-year-olds when they were 15. For this reason, I only use previous BMI for the 35- to 45-year-old group.) In Averett and Korenman's study, there is evidence of some discrimination against obese women, although not African American women. However, the main discrimination seems to stem from the marriage market, as the probability of being married and spouse's earnings (which we can obtain using the NLSY79 but not using NHANES) accounts for a large portion of the difference in economic status.[31] Averett and Korenman find mixed effects for males.

John Cawley uses the NLSY79 data set also, and reaches a similar result in his paper *Body Weight and Women's Labor Market Outcomes.* Cawley looks at the study by Jose Pagan and Alberto Davila (1997), in which they use the same data set but the year 1989 rather than 1988. Cawley believes that the instruments they use in order to correct for endogeneity are not good ones, as they are correlated with the error term. In addition, he believes that if a panel data set such as the NLSY is used, more than one year should be studied. In the appendix to his paper, Cawley describes how he uses the NHANES III data set in order to correct for the self-reported weight and height in the NLSY79. This is one big advantage to the National Health and Nutrition Examination Survey: It reports actual weight and height rather than self-reported values.

NHANES III is a cross-sectional data set done by the United States Department of Health and Human Services, National Center for Health Statistics. The data runs from 1988 to 1994, and can be found on the Center for Disease Control and National Institute

[31] This can be seen in detail in Averett and Korenman (1994).

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of Health websites.[32] Primarily health-oriented, it consists of interview questions as well as physical examinations, based on a random sample of individuals of all ages in the United States. I focus on 25- to 45-year-olds in this exercise. Not everyone takes the physical examination, and I use only those that do in my sample, as I am using actual weight and height. Since NHANES III contains both actual weight and height, and self-reported weight and height, it is possible to compare actual and self-reported weight and height.

As the dependent variable, I take the natural log of family income, as earnings tend to be skewed to the right. I analyze the effect of body mass index on earnings OLS regressions. As a standard, I use a body mass index of 25 kg/m^2 or greater to mean that the individual is overweight, and a body mass index of 30 kg/m^2 or greater to indicate that the individual is obese. Note, however, that what is ideally healthy might not coincide with what society views as right. An example of this is the fact that many models are too thin – in fact unhealthy – and yet are viewed by many as ideal in terms of weight.

I control for demographic characteristics, such as age, education, race, and marital status. I also run regressions without marital status. In some regressions, I include the region of the United States as a dummy variable, a variable *child* indicating whether or not the respondent has any children, and *health limitation*, indicating inability to work due to health problems. The estimating equation takes the following form:

$$\ln(income) = \alpha_0 + \alpha_1(bmi) + \alpha_2 X + \alpha_3 R + e,$$

[32] Geographic identifiers are not available on the website and are not used in this exercise.

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where *X* is a vector of demographic variables (which could include *child* and *health limitation* dummies), *R* is region (northeast, west, south, or midwest), and *e* is the error term. As previously mentioned, I also analyze the difference between actual weight and self-reported weight, and actual height and self-reported height, in order to see the direction of the bias.

The potential endogeneity of body mass index could be problematic. Similarly to what Averett and Korenman did in their paper, I take the body mass index of the respondent from ten years prior, *old bmi*, and do the same analysis using previous BMI in place of current BMI. We should be cautioned, however, that using *old bmi* for this cross-sectional data set means that it will be self-reported.

Results using current body mass index are given in Tables 5.3 and 5.4. Marital status variables were excluded in the first column. The coefficient for BMI is negative and statistically significant, and even more significant for the older age group, indicating the predicted inverse relationship between income and BMI. Results using previous body mass index are reported in Table 5.5[33], which verify the previously obtained result. The coefficients on old BMI are negative and statistically significant at the 5% level.

Results indicate that income also rises with education. Family income is higher if the respondent is married (an obvious relationship, as family income is that of the whole family, often coming from more than one source), and lower if the respondent has a child. The latter is insignificant for the second age group. Being limited in work due to adverse health conditions is negatively correlated with family income but is insignificant.

NHANES has the advantage of having both objective as well as self-reported measures of height and weight. In order to compare actual height and weight with self-

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reported BMI, we can look at Tables 5.6 and 5.7. In general, females between the ages of 25 and 34 tend to overreport height and underreport weight.

This exercise has possibly provided more evidence of the negative effect that body mass index has on income for females, after controlling for demographic variables and possible endogeneity. This thus provides some evidence of discrimination in the workplace – not only of those who are obese, but of women. Sure enough, it has been suggested that obesity is also a feminist issue (Critser 2003), a response to the inequality of the sexes.

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[33] Results using current body mass index for the same sample are also reported in Table 5.5.

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Table 5.3

Log of Income Regressions, Females 25 to 34 Years of Age

Independent variables	(1)	(2)	(3)
Body mass index	-0.0065** (-2.26)	-0.0070** (-2.55)	-0.0062** (-2.25)
Age	0.0160** (2.33)	0.0103 (1.56)	0.0116* (1.75)
Some high	-0.0514 (-0.68)	-0.0088 (-0.12)	-0.0002 (-0.00)
High	0.3934*** (5.88)	0.3988*** (6.23)	0.4043*** (6.33)
Some college	0.6161*** (8.41)	0.6175*** (8.83)	0.6068*** (8.68)
College	0.9395*** (11.93)	0.9423*** (12.51)	0.9123*** (11.84)
Black	-0.5988*** (-12.32)	-0.4417*** (-9.14)	-0.3950*** (-8.01)
Hispanic	-0.2955*** (-5.74)	-0.2853*** (-5.82)	-0.3136*** (-6.10)
Other	-0.0551 (-0.31)	-0.1072 (-0.64)	-0.1679 (-1.00)
Married		0.4550*** (10.24)	0.4961*** (10.77)
Divorced		-0.1187** (-2.00)	-0.0806 (-1.34)
Widowed		-0.6075** (-2.26)	-0.5627** (-2.10)
Midwest			-0.0416 (-0.62)
South			-0.1123* (-1.84)
West			0.0783 (1.14)
Child			-0.1331** (-2.54)
Health limitation			0.0692 (0.63)
R-squared	0.2408	0.3131	0.3219
Observations	1,703	1,703	1,703

Note: T-statistics are reported in parentheses.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 5.4

Log of Income Regressions, Females 35 to 45 Years of Age

Independent variables	(1)	(2)	(3)
Body mass index	-0.0105*** (-3.68)	-0.0097*** (-3.70)	-0.0096*** (-3.70)
Age	0.0163** (2.54)	0.0171*** (2.89)	0.0185*** (3.17)
Some high	0.1259* (1.65)	0.1521** (2.18)	0.1898*** (2.74)
High	0.5537*** (8.33)	0.5542*** (9.11)	0.5929*** (9.83)
Some college	0.8706*** (11.94)	0.8484*** (12.72)	0.8512*** (12.93)
College	1.1246*** (14.67)	1.0505*** (14.94)	1.0696*** (15.36)
Black	-0.5153*** (-10.57)	-0.3019*** (-6.52)	-0.2631*** (-5.69)
Hispanic	-0.2308*** (-4.22)	-0.2040*** (-4.08)	-0.2764*** (-5.34)
Other	-0.1940 (-1.32)	-0.1297 (-0.97)	-0.2815** (-2.09)
Married		0.5463*** (10.35)	0.5599*** (10.51)
Divorced		-0.2570*** (-4.28)	-0.2440*** (-4.05)
Widowed		-0.0299 (-0.23)	-0.0281 (-0.22)
Midwest			0.2365*** (3.74)
South			0.1207** (2.17)
West			0.4129*** (6.47)
Child			-0.0662 -1.11
Health limitation			-0.0734 -0.82
R-squared	0.2653	0.3879	0.4074
Observations	1,700	1,700	1,700

Note: T-statistics are reported in parentheses.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 5.5

Log of Income Regressions Using Prior Body Mass Index, Females 35 to 45 Years of Age

Independent variable	(1)	(2)
(Current) body mass index	-0.0099*** (-3.48)	
(Old) body mass index		-0.0080** (-2.10)
Age	0.0121* (1.72)	0.0126* (1.78)
Some high	0.1166 (1.49)	0.1113 (1.42)
High	0.5782*** (8.55)	0.5759*** (8.49)
Some college	0.8733*** (11.89)	0.8699*** (11.79)
College	1.0396*** (13.55)	1.0483*** (13.62)
Black	-0.2779*** (-5.58)	-0.3002*** (-6.08)
Hispanic	-0.1895*** (-3.55)	-0.1999*** (-3.74)
Other	-0.1506 (-0.97)	-0.1473 (-0.95)
Married	0.5340*** (9.08)	0.5372*** (9.11)
Divorced	-0.2650*** (-3.99)	-0.2610*** (-3.92)
Widowed	-0.0941 (-0.65)	-0.0725 (-0.50)
R-squared	0.3851	0.3819
Observations	1,469	1,469

(Old) BMI is self-reported based on the question "How much did you weigh ten years ago?"
Note: T-statistics are reported in parentheses.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

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Table 5.6

Actual versus Self-Reported Height, Females 25 to 34 Years of Age

Dependent variable: Actual height	
Independent variable	
Self-reported height	0.8346 (0.0100)
R-squared	0.8097
Observations	1,643

Standard error is reported in parentheses.

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Table 5.7

Actual versus Self-Reported Weight, Females 25 to 34 Years of Age

Dependent variable: Actual weight	
Independent variable	
Self-reported weight	1.0758 (0.0073)
R-squared	0.9293
Observations	1,644

Standard error is reported in parentheses.

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Chapter 6

Discussion

Several causes for the tremendous increase in rates of obesity in the past three decades have been looked at, as well as social and labor market consequences. Our notion of what is normal has changed, as well as our lifestyles, largely a result of economic changes in our environment. An environment where businesses enshroud people with what they believe they want has possibly taken over, where weight-loss drugs are sold at the same time as clothes are being resized to allow a size 6 to become a size 2 and you are met with food at every corner. It is key to identify a problem and its causes before outlining solutions.[34]

Aside from factors described in this work, there are numerous other factors that should be mentioned. Environmental changes include increased stress levels, especially with increased globalization and pressure to succeed. Stress has been known to cause irregular eating habits, particularly hunger pangs at night or in the wee hours of the morning (Brody 2004). Across countries, more developed nations have higher obesity rates (with the United States topping the list). Obesity is thus a disease of affluence, afflicting those countries of abundance. Would the people of the past, who toiled through their workdays and often did not have enough food, have predicted this for the future? Would those who dreamed of time travel have envisioned coming to a future not only of advanced technology, but also of huge adults and well-developed children?

We are at a stage where the population in the United States is growing at a slower pace than its food supply. Agribusiness produces 500 more calories a day than it did 30

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years ago, providing each American with 3,800 calories of food a day (Pollan 2003). We are less stringent with genetic engineering laws in the United States, allowing for genetically modified corn to be converted into high fructose corn syrup for cheaply produced junk food products. In the 1970s, high food costs were upsetting farmers and consumers; therefore, regulations became more lenient and subsidies expanded.

Within a country, however, those with higher incomes tend to have lower rates of obesity, as we have seen. If we isolate the cost of a calorie, we find that, health consequences aside, fast food is a real bargain, in terms of both monetary and time costs. A study that compared foods based on the cost of calories in each ounce provided evidence that energy-dense foods provided the lowest-cost option (Drewnowski and Specter 2004). It has also been suggested that those who live in poor neighborhoods face higher grocery prices and food of lower quality, a serious result that would give even more reason for those with incomes around the poverty level to consume fast food.

The number of per capita vehicle miles driven in Europe are only about 40 percent of those driven in the United States, and not necessarily because Americans need to go farther, but because Europeans tend to substitute public transportation, walking, or biking for driving (Squires 2002). Reid Ewing, Tom Schmid, Richard Killingsworth, Amy Zlot, and Stephen Raudenbush (2003) have attributed part of the increase in obesity to the degree of urban sprawl, or how conducive a city is to exercise. Urban sprawl is defined as the process through which the spread of development across the landscape far outpaces population growth. Those urban areas that offer more transportation choices, are more compact, and have a variety of stores and activity centers within reach have

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[34] Holding fast food companies liable, for example, for the escalating obesity rate is not justified unless the companies have purposely misinformed consumers. Altering personal behavior or influencing government

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lower rates of obesity. Government spending on roadwork and infrastructure may thus have an influence on the obesity rate by subsidizing sprawl.

Obesity costs more in annual medical care expenditures than does cigarette smoking – around $75 billion in 2003. A large percentage of these costs are borne by Medicare, Medicaid, private health insurance companies, and ultimately by the population at large rather than by the obese. These costs have grown by more than 3 percent per year during the past few years. Americans spend $33 billion annually on weight reduction products. There are often serious health risks associated with some of these products that can increase the costs of obesity.

An externality arises when the public price of a good is not fully accounted for in the private price. This could come in the form of a positive externality, as in the case of a flu shot that should be cheaper because it benefits society and not simply the person receiving the flu shot. It could be a negative externality, such as when a steel factory emits pollution and does not include the cost of the pollution it is releasing in the price of steel. Therefore, the government might choose to subsidize flu shots and tax the polluting factory. Obesity is an externality if consumers do not have full information or if third parties (such as Medicare, Medicaid, or private health insurance companies) and ultimately the thin people bear some of the costs. Should the government therefore step in?

Local governments might want to play a big role, and many have done so.[35] We know that differentiated local governments can best cater to individual needs, as people can choose the local government that provides them with the optimal combination of

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action are mechanisms through which solutions can be achieved.

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housing and public services given real estate cost and tax burden (Tiebout 1956). Yet obesity is also a very personal problem. Should the government step in as a pre-commitment device? When a person walks into a restaurant intending to order a salad rather than fries, and ending up ordering the latter, is it for the government to decide that the person's future utility would be increased if the option to buy fries were somehow not available, or not as accessible? The question of whether or not the government should take a truly active role in reversing the obesity trend cannot be answered without further research.

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[35] Some schools in Arkansas, California, Louisiana, New York, Mississippi, and Texas, for example, have put additional restrictions on junk food and encouraged exercise programs.

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