Introduction

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During the past three decades, the United States and most of the rest of the developed world have witnessed a rapid rise in obesity. This trend has stimulated a considerable amount of research by economists dealing with its causes and consequences and with policies to combat it. This volume contains the most recent research that addresses these issues.

The increase in obesity has extremely serious public health consequences because the condition is an important risk factor for premature death and for health problems including diabetes, coronary heart disease, hypertension, and asthma. Obesity puts stress on the health care system and raises medical expenditures. The prevalence of obesity also has implications for productivity losses.

Obesity is measured by the body mass index (BMI), defined as weight in kilograms divided by height in meters squared (kg/m2). According to the World Health Organization (1997) and the National Heart, Lung, and Blood Institute (1998), a BMI value of between 20 and 22 is "ideal" for adults 18 years of age and older regardless of gender in the sense that mortality and morbidity risks are minimized in this range. Adults with a BMI greater than or equal to 30 are classified as obese. An obese child is defined as having a BMI above the 95th percentile based on age- and gender-specific growth charts for children and adolescents.

As shown by the data in Table 1 obesity rates in the U.S. remained steady from approximately 1960 until about 1980. Since then they have spiraled almost out of control. Between 1980 and 2000, the percentage of obese adults grew from 15 percent to 31 percent, and the percentage of overweight children ages 6 through 19 rose from approximately 6 percent to 16 percent.[1] Hence, the number of obese adults doubled, and the number of obese children almost tripled in a period of two decades.

[1] These figures are simple averages of the percentages for children ages 6-11 and ages 12-19.

Some estimates suggest that the increasing prevalence of obesity accounts for approximately 300,000 deaths every year, next only to the preventable mortality associated with cigarette smoking (McGinnis and Foege 1993; Allison et al. 1999). In a more recent study, Flegal et al. (2005) report a smaller but still substantial figure of approximately 112,000 excess deaths in the year 2000. This still exceeds the third and fourth leading causes--alcohol abuse and illegal drug use. Aggregate medical spending for the United States that is attributed to obesity accounted for approximately 10 percent of total annual medical expenditures in recent years (Rashad and Grossman 2004). Obesity costs more in annual medical care expenditures than cigarette smoking--around $147 billion in 2008 (Finkelstein et al. 2009)--because of the long and costly treatments for its complications. 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. To make matters worse, Americans spend $33 billion annually on weight reduction products (Rashad and Grossman 2004). There are often serious health risks associated with some of these products, which can further increase the costs of obesity. These factors underscore why one of the targets of the *Healthy People 2010* initiative of the U.S. Department of Health and Human Services (2000) is to reduce the adult obesity rate to 15 percent and the childhood obesity rate to 5 percent by 2010. The data in Table 1 clearly indicate that these goals will not be met.

Obesity is a complex public health problem, which is related to both individual characteristics that are genetic or acquired and to the individual's economic environment. Medical research has identified a number of potential determinants of obesity including genetic disposition. The stability, however, of obesity until about 1980, and the continuous and dramatic

increase since that year suggest that genetics may not play a very prominent role in the upswing, as genetic change typically does not take place quickly.

Obesity is related to socioeconomic status, and over the last decade economists have begun to investigate the impact of economic factors and incentives on individuals' behaviors that can influence their bodyweight and that of their children. Hence, economic analysis is a potentially useful tool to understand the causes and consequences of obesity. As demonstrated by the papers in this volume, economists can play a role in examining these determinants and consequences, although the factors at work are multifaceted, and the policy prescriptions are by no means straightforward.

The volume consists of twelve papers: four on the determinants of adult obesity, three on the determinants of childhood obesity, two on the determinants of the proximate causes of obesity, and three on the consequences of obesity. Any model of obesity must explain at least some of the determinants of calories consumed and calories expended--the proximate causes of this outcome. This can be accomplished either by examining their direct impacts on obesity or their impacts on caloric intakes via food consumption and on caloric outtakes via physical activity.

The first seven papers take the former approach. They treat the probability of being obese and related weight outcomes as dependent variables. Key determinants in these studies are year- and area-specific food prices, food outlets, gymnasiums and other recreational facilities, participation in weight-loss programs, health insurance, and minimum wages. Some of these variables have subtle effects on weight outcomes. For example, economic theory predicts that bodyweight decisions should be responsive to the incidence of the medical care costs of obesity. If the obese do not pay for their higher medical expenditures through differential payments for

health care and health insurance, the presence of insurance can lead to weight gains. Another example is that minimum wage labor is a major cost in food consumed away from home, especially at fast-food restaurants. Hence, declines in the real minimum wage over time have contributed to reductions in the real price of food consumed away from home and are expected to lead to increases in obesity.

The next two papers shift the emphasis to the determinants of physical activity and food consumption. The study of physical activity focuses on the roles of recreational facilities, transportation costs, and other prices. The study of total food consumption and food consumption patterns emphasizes the effects of policy changes in the food stamp and welfare programs that had causal impacts on food stamp caseloads. As in the obesity studies, some of the factors at work in these two studies are subtle. The food stamp program may have unintended consequences if it frees resources to spend on food that is dense in calories. Increases in cigarette and alcohol taxes may encourage exercise if this activity is a substitute for cigarette smoking or alcohol consumption.

Obesity surely poses health risks, but it may have other negative consequences. The three papers on the consequences of obesity look for effects on educational and labor market outcomes. They are motivated by the possibility that the obese may be less productive in school and in the workplace and may confront discrimination in both settings. In addition, there may be indirect effects of obesity on these outcomes that operate through low self-esteem.

In the first paper in this volume, David O. Meltzer and Zhuo Chen focus on one of the potential subtle determinants of bodyweight mentioned above: the real minimum wage rate. Because the real minimum wage in the United States has declined by 50 percent since 1968 and because minimum wage labor is a major contributor to the cost of food away from home, they

hypothesize that changes in the minimum wage should be associated with changes in bodyweight. They use data from the Behavioral Risk Factor Surveillance System from 1984-2006 to test whether variation in the real minimum wage is associated with changes in body mass index. They also examine whether this association varies by gender, education, and income and use quantile regression models to test whether the association varied over the BMI distribution. Finally, they estimate the fraction of the increase in BMI since 1970 attributable to minimum wage declines.

Meltzer and Chen find that a $1 decrease in the real minimum wage is associated with a 0.06 increase in BMI. This relationship is significant across gender and income groups and largest among the highest percentiles of the BMI distribution. Real minimum wage decreases can explain 10 percent of the increase in BMI since 1970. They conclude that the declining real minimum wage rate has contributed to the increasing rate of obesity in the United States.

The standard household production models of consumer behavior generate a demand function for caloric intakes (Chou Grossman, and Saffer 2004). If adults are fully aware of the consequences of obesity and make deliberate decisions of calorie consumption given prices and income, then they may have internalized the costs associated with being overweight. One important justification of public policy formulated around various interventions is that being obese generates negative externalities. Put differently, some of the costs generated by obese individuals are shouldered by others. For example, if an increase in the obesity rate in the population raises health insurance premiums for everybody because premiums are not adjusted for the risk of obesity-related illness, then non-obese individuals face higher health insurance premiums imposed upon them by obese individuals. Furthermore, and more important from a social welfare point of view, obesity may generate moral hazard in insurance coverage. That is,

pooled heath insurance may cause people to gain weight because weight gain is not associated with higher insurance premiums.

In the second paper in this volume Jay Bhattacharya, M Kate Bundorf, Noemi Pace, and Neeraj Sood use data from the Rand Health Insurance Experiment conducted in the 1970s and early 1980 to investigate the extent to which the generosity of health insurance coverage impacts bodyweight among approximately 2,400 non-elderly families. The authors do not find evidence that insurance plans with higher cost-sharing induce a change in the BMI. On the other hand, when they analyze the decision at the extensive margin, they find that bodyweight in fact responds to insurance coverage. For this analysis they employ the National Longitudinal Survey of Youth (NLSY), covering the years of 1989-2004. They investigate the impact of the existence of private or public health insurance coverage on bodyweight, accounting for unobservable attributes of the individual that impact both the choice of health insurance and the health outcomes, such as bodyweight. Bhattacharya, Bundorf, Pace, and Sood report that being insured leads to a greater body mass index and a higher probability of being obese.

Although there is evidence in the economics literature on the impact of food prices on bodyweight in the short-run (Chou, Grossman and Saffer 2004; Auld and Powell 2009), evidence on the long-run consequences of food prices is scant. In the third paper in this volume, Dana Goldman, Darius Lakdawalla, and Yuhui Zheng use data from the Health and Retirement Study to investigate this issue. Individuals in this longitudinal data set were over the age of 50 when they were first interviewed in 1992. The authors use a sample of more than 3,000 individuals who were observed in four waves between 1992 and 2004. The authors find that in the short-run the elasticity of bodyweight with respect to the price of calories is -0.063. This is likely to be a lower-bound estimate due to the potential endogeneity of local food prices and likely

measurement error in these prices. The long-run elasticity is bigger. Within 30 years a 10 percent permanent reduction in price per calorie leads to a BMI increase of 1.5 units, or 3.6 percent, suggesting that an increase in the price of calories might reduce the rate of weight growth in the long-run although the short-run impact might be negligible for older adults.

The assumption that consumers have rational expectations about the frequency of their future consumption behavior has been shown to be violated in some settings. For example, DellaVigna and Malmendier (2006) analyze data from health club memberships and demonstrate that consumers' behavior regarding membership and attendance of health clubs is not consistent with standard models of preferences, but can better be explained by over-confidence about future self-control. Along these lines, O'Donoghue and Rabin (1999, 2001) underline time-inconsistent and present-biased preferences and demonstrate the emergence of procrastination when choices involve immediate costs and delayed rewards. Consideration of such preferences are important in the case of obesity because attempts to lose weight typically involve immediate reduction in utility (a reduction of food consumption and an increase in physical effort to exercise), but a delayed benefit (weight loss and health benefits that are achieved after periods of effort). Thus, additional external incentives may be helpful in motivating overweight individuals to alter their behavior.

One such incentive, analyzed by John Cawley and Joshua A. Price in the fourth paper in this volume, is financial rewards for weight loss. The authors employ data from a firm that coordinates a program of financial incentives for weight loss in various worksites. Using data on 2,407 employees in 17 worksites who participated in a year-long program, Cawley and Price study attrition and weight loss in three types of programs: one that offers no financial rewards for weight loss, one that offers quarterly payments based on the percentage of loss from baseline

weight, and a third that takes bonds that are refunded only if the employee achieves a specified weight loss goal and a quarterly lottery drawing gives away prizes to those who have lost some weight. The authors document higher attrition rates than found by previous studies. Financial rewards are associated with modest weight reductions. After one year, participants in the program that required posting a bond lost 1.9 pounds more than those in the control group that faced no financial incentives. The weight loss of those who were on the quarterly payment program was no different than those in the control group.

Chou, Grossman, and Saffer (2004) report that the growth of fast-food restaurants and the declines in the prices of food consumed in these restaurants and in a broad measure of the price of food consumed at home explain a significant portion of the growth in adult obesity. In the fifth paper in this volume, Lisa M. Powell and Frank J. Chaloupka investigate the impacts of more narrowly defined food prices and several different types of food outlets on childhood obesity. They employ data drawn from the Child Development Supplement of the Panel Study of Income Dynamics, merged with food price data and food outlet density data at the zip code level. They measure food prices by a fruit and vegetable price index (the price of "healthy" food) and a fast food price index (the price of "unhealthy food). In addition, they distinguish among the effects of three food outlet density measures: the number of supermarkets per 10,000 residents per 10 square miles, the density of grocery stores measured the same way, and the density of convenience stores. This distinction is important because fresh fruits and vegetables are more readily available at supermarkets and grocery stores than at convenience stores. Their use of the zip code, as opposed to a larger geographic area, to merge prices and outlets, minimizes the amount of measurement error in these variables.

The authors report that some of the variables just mentioned explain part of the BMI gap between high-socioeconomic status (SES) children and low-SES children. Specifically, higher fruit and vegetable prices are related to higher BMI among low-SES children, but the relationship is not significant for high-SES children. Similarly, increased supermarket availability has a negative impact on the BMI of low-SES children and increased presence of convenience stores is associated with higher BMI for the same group, while these two types of stores have no impact on the bodyweight of high–SES children.

In the sixth paper in this volume, Bisakha Sen, Stephen Mennemeyer, and Lisa C. Gary investigate the link between aspects of the local neighborhood other than food prices and food outlet density and BMI of children. The authors use the Children of the NLSY79 (CoNLSY) data, where children in the data are those who were born to the female respondents of the NLSY79 survey. By design, the CoNLSY includes only those children who are 15 years of age or younger. Their particular concern is with the impact of maternal perception of overall quality of the neighborhood. This is given by the response to a question as to whether the mother rates her neighborhood as an excellent, very good, good, fair, or poor place to raise her children.

The authors find that neighborhood quality is not associated with the BMI of the child, but one particular attribute--the perceived level of police protection is related to this outcome. In particular, for black and Hispanic children, BMI percentiles are lower when mothers report a higher perceived level of police protection. They note that it is difficult to identify the channels through which the perception of the extent of police protection is influenced. For example, although crime rates in the country of residence might be theoretically related to the perception of police protection, crime rates are impacted by police presence, and such endogeneity makes it difficult to identify the impact of local crime on perception of police protection. On a positive

note, they propose that a potential causal pathway between perceived inadequacy of police protection in the neighborhood and BMI may go through sedentary behavior. For example, if mothers are concerned about safety of their children, they may choose to allocate less of their children's time to outdoor physical activities more time towards indoor sedentary activities, such as TV watching at home. Sen, Mennemeyer, and Gary find that, when mothers report inadequate police protection in their neighborhood, their children spend 20 minutes more per day watching TV.

The seventh paper in this volume by Robert Sandy, Gilbert Liu, John Ottensmann, Rusty Tchernis, Jeffrey Wilson, and O.T. Ford also analyzes the impact on children's BMI of the environment in which they live. Specifically, the authors consider a large set of environmental factors including fast-food restaurants, supermarkets, parks, trails, violent crimes, and 13 types of recreational amenities derived from the interpretation of annual aerial photographs. They obtain height and weight information as well as data on personal characteristics of children ages 3-18 are obtained using data from a pediatric clinic in Indianapolis. A unique aspect of their study is that they know the exact address of each child. Hence, they can measure environmental variables at very small radiuses ranging from one tenth of a mile to one mile from the child's residence.

The authors emphasize the results of the estimation of an individual fixed effects model obtained from successive visits to the clinic between 1996 and 2006 by children who stayed at the same address. This allows them to analyze the impacts of changes in environmental factors on changes in BMI while controlling for time-invariant unmeasured characteristics of neighborhoods. For example, if new recreational facilities are built in neighborhoods in which

parents have strong preferences for healthy children and these facilities, the cross-sectional relationship between BMI and the facilities will be overstated in absolute value.

The relationship between some of the environmental factors and children's BMI is unclear in fixed effects specifications, and the results display some sensitivity to how access to amenities is defined. For example, if fast-food restaurants are measured within a quarter of a mile or half a mile from the child's home, the impact on BMI is negative, whereas the impact is positive if one considers the fast food restaurants within a mile radius. The recreational amenities that appear to lower children's BMI are fitness areas, kickball diamonds, and volleyball courts. The authors estimate that locating these amenities near their homes could reduce the weight of overweight eight-year old boys by 3 to 6 pounds.

Neeraj Kaushal and Qin Gao treat patterns of food consumption, key proximate determinants of caloric intakes and bodyweight, as outcomes in the eighth paper in this volume. Obesity is more prevalent among low-income families, and they analyze the extent to which food consumption patterns of low-income families respond to the changes in the food stamp program. They use data from the 1994-2004 Consumer Expenditure Survey and focus on families with children and where mothers had at most a high school education. They form a treatment group consisting of families headed by single mothers, and a control group consisting of families with two parents. They assume that the former group is much more likely to receive food stamps than the latter. Their analyses show that per capita food expenditures of low-educated single-parent families are not related to food stamp caseloads (number of recipients) in the corresponding state. That is, expansions in the food stamp program do not appear to have any impact on food expenditures as well as on most food items for low-income families. Kaushal and Gao also find that the welfare reform in the 1990s lowered the food stamp caseload and that the introduction of

simplified reporting procedures and electronic benefit transfer cards were associated with an increase in caseloads. There is no evidence, however, that these changes had any effect on spending on food for low-income families.

The above conclusions are subject to a several qualifications. First, the authors cannot identify food stamp recipients with certainty. That is, some of the families in the treatment group may not benefit from this program, and some of the families in the control group may benefit from it. Second, they lack data on food stamp benefits. It is possible that increases in caseloads were accompanied by reductions in real benefits.

In the ninth paper in this volume, Melayne M. McInnes and Judy A. Shinogle focus on an obvious mechanism to increase caloric outtake: namely, physical exercise. They analyze the determinants of self-reports of this measure for adults in the 2001, 2003, and 2005 Behavioral Risk Factor Surveillance System (BRFSS). Their emphasis is on the effects of household income, education, and broadly defined correlates of the price of exercise such as the availability of parks and gyms in the county of residence, local transportation costs, and the value of time allocated to exercise. In addition, they consider the impacts of the prices of goods that may be substitutes for exercise. For example, excise tax hikes on cigarettes and alcohol will promote exercise if "sin goods" and exercise are substitutes.

The authors find that income and education have strong and consistently positive effects on physical activity. The latter finding underscores the protective effect of education on health that operates through channels other than income (Grossman 2006). Employed people have lower propensities to exercise than others, which reflects the importance of the opportunity cost of exercising. Physical exercise is more likely when there are more parks and gyms per capita in a county and also is more likely when transportation costs, proxied by the price of gasoline, are

lower. One surprising finding is that sin taxes have negative effects on vigorous exercise or moderate and vigorous exercise.

The results just summarized control for state and year, but not county, fixed effects. It is possible that individuals with preferences for physical fitness choose to live in localities with better access to these facilities. The authors argue that, if the taste for physical fitness is correlated with the taste for wellness, then the information on whether or not the individual has a flu shot can be used as control for the taste for exercise. Inclusion of an indicator for a flu shot does not change the results. Nevertheless, it should be kept in mind that the sample period is short, which limits the extent of within area variation over time.

The last three papers in this volume focus on the consequences of obesity in domains other than health outcomes. Robert Kaestner, Michael Grossman, and Benjamin Yarnoff analyze the impact of obesity on educational attainment. Obesity can affect education through a number of channels. Potential peer and teacher discrimination related to weight may adversely affect educational achievement. Obesity can impact education through its impact on poor health and through a potential association with cognitive difficulties. Kaestner, Grossman and Yarnoff use data from the National Longitudinal Survey of Youth 1997, drawn from the surveys years 1997 to 2002, and focus on individuals between the ages of 14 and 18. They measure educational attainment by highest grade attended, highest grade completed, and whether the student had dropped out of school. The results indicate that there is no systematic relationship between weight and educational attainment. It is possible that the small and statistically insignificant estimates are due to data issues: measurement error in height and weight is possible as these are self-reported in the NLSY; there is lack of variation in the dependent variable since only five-to-

ten percent of the sample fail to progress in grade or drop out; and relatively small numbers of teens are in the upper and lower tails of the weight distribution.

Increases in weight can have negative effects on wages through channels related to discrimination and productivity. In addition, wage cuts, rather than insurance premium hikes, may be a mechanism via which the obese pay for the excess medical care costs. Finally, a negative relationship between physical attractiveness and BMI may account for part of the impact of BMI on wages. In the eleventh paper in this volume, Christian A. Gregory and Christopher J. Ruhm use data on 25-55 year olds from the 1986, 1999, 2001, 2003 and 2005 waves of the Panel Study of Income Dynamics to study these issues. Since some of these mechanisms imply nonlinear BMI effects, they estimate semi-parametric wage equations. In some specifications, they address potential endogeneity of BMI by using sibling BMI as an instrument and by employing at least 13-year-lagged values BMI to avoid reverse causality from wages to BMI.

Gregory and Ruhm estimate gender-specific wage regressions and find that women's wages peak at around the BMI level of 23, which is well below the obesity cut-off of 30. They report similar results for men in instrumental variables models or in those that employ long lags of BMI. For men, the estimated wage-BMI profile is reasonably flat with a peak at around the overweight range of a BMI of 25. There is, however, little evidence that serious health effects occur in this range. Moreover, the results of instrumental variables (IV) models or specifications focusing on long-lags of BMI for men are more similar to those for women. The findings for females (and the IV and lag estimates for males) suggest that it is not obesity but rather some other factor--such as physical attractiveness--that produces the observed relationship between BMI and wages.

Gregory and Ruhm also use data from the Medical Expenditure Panel Survey to estimate total health expenditures as a function of BMI. The pattern of the medical expenditure-BMI profile for women suggests that medical costs do not explain the behavior of wages for women as the medical expenditures start rising after a BMI of 30, while wages decline after a BMI 23. For men, a monotonically increasing medical expenditure-BMI profile is detected. This finding has some potential for explaining wage behavior in specifications that employ actual BMI but not in those that employ IV or long lags of BMI.

Recently, economists have identified the importance of non-cognitive factors in wage determination. In the final paper in this volume, Naci Mocan and Erdal Tekin point out that self-esteem is one of these factors and that it in turn can be influenced by BMI and obesity. They use data from the National Longitudinal Study of Adolescent Health to analyze the interplay between BMI, self-esteem, and wages among young adults in the age range of 21 to 26 in 2001-2002. They hypothesize that, in addition to its direct impact on wages, obesity can influence wages indirectly through self-esteem.

Mocan and Tekin find that BMI has an independent effect on self-esteem for females and for black males. The authors also find that there is a wage penalty for being obese for both white and black women. In addition, self-esteem has an impact on wages in the case of whites. Taken together, the results suggest that obesity has the most significant impact on white women's wages because their wages are affected directly by obesity and indirectly through the impact of obesity on self-esteem. These results differ from those in the study by Gregory and Ruhm in part because different age groups and different measures of bodyweight are employed in the two studies.

What have we learned from these twelve papers? Clearly, weight outcomes and their determinants respond to broadly defined measures of prices. Goldman, Lakdawalla, and Zheng report an inverse relationship between the price of a calorie and BMI. Meltzer and Chen show that bodyweight is positively related to the minimum wage and argue that is because the price of fast food falls when the minimum wage falls. Powell and Chaloupka's findings can be interpreted as evidence that an increase in the price of fruit and vegetables relative to the price of caloric food leads to a rise in obesity.

The negative effect of the availability of supermarkets and the positive effect of the availability of convenience stores on obesity in the Powell-Chaloupka study point to the role of transportation costs required to obtain food (the sum of direct outlays on modes of transportation and shopping time valued at its opportunity cost) in weight outcomes. Similar interpretations apply to the negative effects of recreational facilities on children's bodyweight uncovered by Sandy, Liu, Otteensmann, Tchernis, Wilson, and Ford and to the positive effects of these facilities on exercise by adults uncovered by McInnes and Shinogle. The negative impact of gasoline prices on exercise and the negative differential in this activity between employed persons and others in the latter study highlight money and time prices as rationers of this activity.

Some of the estimated price effects are subtle. For example, Bhattacharya, Bundorf, Pace, and Sood find that being insured leads to higher BMI and a larger probability of being obese because weight gain is not associated with higher premiums in pooled health insurance plans. To cite another example, the negative relationship between cigarette taxes and exercise in the McInnes-Shinogle study suggests complementarity between sin goods and exercise, possibly because food consumption and exercise are substitutes. Chou, Grossman, and Saffer (2004) report that an increase in the price of cigarettes leads to higher bodyweight and argue that is

because cigarette smoking and food consumption are substitutes. While intuition suggests substitution between smoking and exercise, that relationship appears to be dominated by substitution between smoking and food consumption.[2]

What insights do the papers offer with regard to the sources of the upward trend in obesity during the past three decades? Several papers point to reductions in the real prices of unhealthy foods and increases in the prices of healthy foods in the period at issue as contributory factors. Increases in the proportion of the population covered by health insurance, perhaps with a lag, is another contributory factor. Large cigarette excise tax hikes that have accompanied the anti-smoking campaign may have had unintended consequences. Increases in the value of time, especially of women, due to their rising labor force participation rates, make it more costly for them to exercise. Previous studies (for example, Anderson, Butcher, and Levine 2003) have identified this trend as a partial explanation of the growth in obesity among children. Finally, reductions in population density due to urban sprawl (a low density development pattern, which changes the built environment in which individuals reside) have negative consequences for the proximate determinants of exercise that been shown to have important impacts on this activity in several papers in this volume.[3]

The papers that address the education and labor market effects of excessive bodyweight reveal that the economic consequences of obesity are complex. Kaestner, Grossman, and Yarnoff find that overweight teens have about the same levels of educational attainment as teens of normal weight. One explanation is that the overweight offset the factors associated with poor health and discrimination by allocating more time to schoolwork and less time to sports and other leisure time activities. Gregory and Ruhm report that the observed negative relationship

[2] Courtemanche (2009) reaches somewhat different conclusions using specifications that allow for lagged effects.
[3] See Zhao and Kaestner (2009) for a summary of the literature on the effects of urban sprawl on obesity and some new estimates.

between obesity and wages is not caused by obesity per se but rather by a factor such as physical attractiveness or discrimination. Mocan and Tekin present suggestive evidence that this negative relationship between obesity and wages can be attributable in part to low self-esteem on the part of the obese.

The studies in this volume employ very different data and methods and do not include a unified set of determinants of obesity. Hence, they cannot be used to provide a complete accounting of the sources of the growth in weight. But they do provide a firm foundation for future research in this key area. A similar comment applies to the studies on the consequences of obesity.

What are the implications of the papers in this volume for public policy? If obesity were purely a cosmetic problem, the pressing need for solutions to reverse it would not seem necessary. Yet obesity has been linked to various medical conditions and poor health outcomes. Clearly, obesity carries a high personal cost. But does it carry a high enough social cost to make it a concern of public policy? The case for government intervention is weakened if consumers are fully informed, and if the obese bear all the consequences of their actions. The case is strengthened if consumers do not have full information or something that reasonably approximates it, or if third parties like Medicare, Medicaid, private health insurance companies and ultimately the non-obese end up bearing significant amounts of the costs.

In the case of children, one justification for government intervention is that society as a whole may reap substantial current and future production and consumption benefits from improvements in children's health. The case is strengthened because overweight children are extremely likely to become obese adults and because children are less likely to have information about the consequences of their actions or to heavily discount these consequences. The case is

weakened because parents may more easily and immediately affect the choices made by their children than can the government.

With these caveats in mind, we note that the papers in this volume that report that reductions in real food prices can account for part of the increase in obesity bear on the question of whether taxes on food, especially dense and high-caloric fast food and soda, provide an effective public policy tool for addressing obesity. But it is possible that a tax on fast food could actually increase caloric intakes via substitution towards non-taxed food. Moreover, Yaniv, Rosin, and Tobol (2009) develop a theoretical model in which fast-food or junk-food taxes increase obesity for health-conscious consumers who increase the time they allocate to the preparation of healthy meals at the expense of exercise.

An alternative policy might be financial rewards for weight loss. But Cawley and Price find very small average weight loss associated with worksite programs with this feature in their paper in this volume. One interpretation of this finding is that consumers are time inconsistent and have present-biased preferences. Gruber and Köszegi (2001) show that very stiff excise tax hikes or other policies to increase the cost of consuming the good in question are required in this situation. But Becker (2009) interprets the failure of weight loss programs and the upward trend in obesity as the response of rational and forward-looking consumers to past, current, and anticipated future medical innovations that have reduced and are expected to reduce the health consequences of being overweight. Bhattacharya and Packalen (2008) go one step further and point out that there is a positive externality from the upward trend in obesity because it induces medical research on, for example, heart attacks and diabetes that will benefit the non-obese as well as the obese.

Other results in the papers in this volume carry mixed messages with regard to public policy. For example, whether the evidence that access to parks, gymnasiums, and other recreational facilities increase exercise and reduce obesity bears directly on the suggestion that such facilities should receive public subsidies not only depends on the issues raised above but also depends on the extent to which people with unobserved tastes for physical activities choose to locate in areas with better access to these facilities. Effective policy levers exist to make it easier or harder for low-income groups to obtain food stamps. But these levers do not appear to change food consumption patterns in ways that promote weight gain or healthy food choices based on the evidence presented by Kaushal and Gao in their paper in this volume. To cite a final example, the labor market benefits of policies to combat obesity may be significantly smaller than the benefits of policies that seek to improve outcomes in these settings for the obese by reducing discrimination or improving self-esteem.

Perhaps the main message of the papers in this volume and related current research on economic aspects of obesity is that there is no free lunch, that with benefits come costs. Positive changes such as increases in technology that lowered the real price of food, reduced smoking, and increased female participation in the labor force have also carried unforeseen negative consequences. Was the anti-smoking campaign a mistake if it also encouraged obesity? Of course, we do not believe people should start smoking in order to become thin, substituting one type of unhealthy behavior for another. This was simply one of the unintended consequences of social change and government action. Nor do we suggest that women abandon the labor force to provide their families with home-cooked meals. Whether public policies should be pursued that offset the ignored or unanticipated consequence of previous policies that contributed to the rise

in obesity will depend, in the end, on evaluations of the external costs and benefits of these policies. We hope that the papers in this volume will contribute to this exercise.

References

Allison, David B., Kevin R. Fontaine, JoAnn E. Manson, June Stevens, and Theodore B. VanItallie. 1999. "Annual Deaths Attributable to Obesity in the United States." *Journal of the American Medical Association* 282(16): 1530-8.

Anderson, Patricia M., Kristin F. Butcher, and Phillip B. Levine. 2003. "Maternal Employment and Overweight Children." *Journal of Health Economics* 22(3): 477-504, May 2003.

Auld, M. Christopher, and Lisa M. Powell. 2009. "Economics of Food Energy Density and Adolescent Body Weight." *Economica* 76(304): 719-740.

Becker, Gary S. 2009. "The Growth in Obesity." www.becker-posner-blog.com. August 2.

Bhattacharya, Jay, and Mikko Packalen. 2008 "The Other Ex-Ante Moral Hazard." National Bureau of Economic Research Working Paper No. 13863.

Centers for Disease Control and Prevention. 2009. "CDC Growth Charts." www.cdc.gov/growthcharts, last accessed June 23.

Centers for Disease Control and Prevention. 2009. "Obesity and Overweight for Professionals: Childhood: Contributing Factors." www.cdc.gov/obesity/childhood/prevalence.html, last accessed June 23.

Chou, Shin-Yi, Michael Grossman, and Henry Saffer. 2004. "An Economic Analysis of Adult Obesity: Results from the Behavioral Risk Factor Surveillance System." *Journal of Health Economics* 23(3): 565-587

Courtemanche, Charles. 2009. "Rising Cigarette Prices and Rising Obesity: Coincidence or Unintended Consequence? *Journal of Health Economics* 28(4): 781-798.

DellaVigna, Stefano, and Ulrike Malmendier. 2006. "Paying Not to Go to the Gym." *American Economic Review* 96(3): 694-719.

Finkelstein, Eric A., Justin G. Trogdon, Joel W. Cohen, and William Dietz. 2009. "Annual Medical Spending Attributable to Obesity: Payer- and Service-Specific Estimates." *Health Affairs* 28(5): w822-w831.

Flegal, Katherine M., Barry I. Graubard, David F. Williamson, and H. Gail Mitchell. 2005. "Excess Deaths Associated with Underweight, Overweight, and Obesity." *Journal of the American Medical Association* 293(15): 1861-67.

Grossman, Michael. 2006. "Education and Nonmarket Outcomes." In Handbook of the Economics of Education, Volume 1 edited by Hanushek, Eric, and Finis Welch. Amsterdam: North-Holland, Elsevier Science: 577-633.

Gruber, Jonathan, and Botond Köszegi. 2001. "Is Addiction 'Rational'? Theory and Evidence." *Quarterly Journal of Economics* 116(4): 1261-1303.

McGinnis, J. Michael, and William H. Foege. 1993. "Actual Causes of Death in the United States." *Journal of the American Medical Association* 270(18): 2207-12.

National Center for Health Statistics. 2009. *Health United States 2008*. Hyattsville, MD: National Center for Health Statistics.

National Heart, Lung, and Blood Institute, National Institutes of Health. 1998. "Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults-The Evidence Report." *Obesity Research* 6(Supplement 2): 51S-215S.

O'Donoghue, Ted, and Matthew Rabin. 2001. "Choice and Procrastination." *Quarterly Journal of Economics* 116(1): 121-60.

O'Donoghue, Ted, and Matthew Rabin. 1999. "Doing It Now or Later." *American Economic Review* 89(1): 103-24.

Rashad, Inas, and Michael Grossman. 2004. "The Economics of Obesity." *The Public Interest* 156(Summer): 104-112.

U.S. Department of Health and Human Services. 2000. *Healthy People 2010*. Second Edition. Washington, DC: U.S. Government Printing Office.

World Health Organization. 1997. *Obesity: Preventing and Managing the Global Epidemic*. Geneva: World Health Organization.

Yaniv, Gideon, Rosin, Odelia, and Tobol, Yossef. 2009. "Junk-Food, Home Cooking, Physical Activity and Obesity: The Effect of the Fat Tax and the Thin Subsidy." *Journal of Public Economics* 93(5-6): 823-830.

Zhao, Zhenxiang, and Robert Kaestner. 2009. "Effects of Urban Sprawl on Obesity." National Bureau of Economic Research Working Paper No. 15436.

Table 1

Trends in the Prevalence of Obesity, by Age and Period

	1960-1962	1963-1965	1966-1970	1971-1974	1976-1980	1988-1994	1999-2002	2003-2006
	Percentage of Population[a]							
Ages 2-5	n.a.[b]	n.a.	n.a	n.a	5.0	7.2	10.3	12.4
Ages 6-11	n.a	4.2	n.a.	4.0	6.5	11.3	15.8	17.0
Ages 12-19[c]	n.a	n.a	4.6	6.1	5.0	10.5	16.0	17.6
Ages 20-74[d]	13.3	n.a	n.a.	14.6	15.1	23.3	31.1	34.1

Sources: National Center for Health Statistics (2009), Health United States 2008, Tables 75 and 76 and www.cdc.gov/obesity/childhood/prevalence.html.

[a]For children, obesity is defined as body mass index (BMI) at or above the sex- and age-specific 95th percentile
BMI cutoff points based on Centers for Disease Control and Prevention growth charts. See http://www.cdc.gov/growthcharts. For adults, obesity is defined by BMI greater than or equal to 30.

[b]Not available.

[c]Ages 12-17 in 1966-1970.

[d]Age-adjusted.