School of Economic Sciences

Working Paper Series
WP 2007-16

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March, 2007

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WHY THE POOR GET FAT: WEIGHT GAIN AND ECONOMIC INSECURITY[1]

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ABSTRACT: Something about being poor makes people fat. Though there are many possible explanations for the income-body weight gradient, we investigate a promising but little-studied hypothesis: that economic insecurity acts as an independent cause of weight gain. We use data on working age men from the 1979 National Longitudinal Survey of Youth (NLSY79) to identify the effect of various measures of economic insecurity on weight gain. We find in particular that over the 12-year period between 1988 and 2000, a one point (0.01) increase in the probability of becoming unemployed causes weight gain over this period to increase by about one pound, and each realized drop in annual income results in an increase of about 5.5 pounds. The mechanism also appears to work in reverse, with health insurance and government "social safety net" payments leading to smaller weight gains.
Date revised: *March 30, 2007*
JEL Codes: D12, I12, I18, I38, J22, J65
Key Words: obesity, unemployment, moral hazard, NLSY79.

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[1] The authors thank Orley Ashenfelter, Linda Blumberg, Deborah Chollet, George Davis, Adam Drewnowski, Ted Frech, Jacob Hacker, Ray Huffaker, Tom Marsh, Joseph Newhouse, Len Nichols, Tim Richards, Christopher Ruhm, Robert Sapolsky, Kosali Simon, Jon Yoder, Parke Wilde, and participants in the research seminars at Washington State University and Western Washington University for helpful discussions and comments.

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Worries go down better with soup than without.
--Jewish proverb

Everyone knows why people gain weight: They eat too much. Or exercise too little. Or lack self-control. Or live in a world of abundant, low-cost calories. Or maybe it just runs in the family.

That body weight is a function of a multitude of economic decisions—that is, decisions involving market transactions either directly (e.g., via the purchase of food, or labor-saving devices, or athletic club memberships) or indirectly (e.g., via the allocation of scarce leisure time to physical exertion)—is beyond dispute. But as an economic decision problem, weight gain is intriguing because economic explanations must compete with (or be reconciled with) explicitly *non*-economic explanations from other fields, from psychology and sociology to nutrition science and even molecular genetics. In this article we focus on a particular purported cause of weight gain—economic insecurity—which is both related to popular theories from psychology and consistent with theory and evidence from behavioral biology.

Economic insecurity—defined, roughly speaking, as the risk of catastrophic income loss faced by an individual or household—has not received much attention as an independent cause of obesity from economists or advocates of public health.[3] But viewed from the perspective of behavioral biology, the motivation for a relationship between insecurity and body fat is obvious: the reason humans and other animals evolved the ability to store body fat was presumably because it was necessary to survive periodic food shortages. The evidence for this is surprisingly strong. It has been demonstrated again and again, for instance, that animals in natural environments face very real periodic starvation risk, and that such risk is a strong predictor of fattening behavior (e.g., Ekman and Lilliendahl 1993, Shively and Wallace 2001). It therefore seems reasonable to ask whether weight gain in humans might be—at least in part—the manifestation of an optimal fattening response to economic insecurity.[4] In the pages that follow, we briefly review

[3] A notable exception is to be found in a case study (Dietz 1995) of a young girl whose mother reported a monthly cycle of feast and famine (evidently induced by the manner in which food stamps and other social services payments were dispersed). The author conjectured that the girl's obesity might be a biologically induced response to periodic food shortage. The dramatic relationship between food stamp distribution dates and dietary intake has since been confirmed empirically (Wilde and Ranney 2000, Wilde and Andrews 2000).

[4] It is important to note that in humans, the mechanisms by which economic security might generate weight gains are likely to be deeply rooted in psychological and neuroendocrine systems (see Smith 2006 for a review). One implication of this fact is that indicators of economic insecurity in modern human populations need not be associated with any appreciable real (or even perceived) risk of death by starvation in order to affect behavior and energy metabolism. The potential for such an "evolutionary mismatch" generated by

previous studies of obesity, report the results of new empirical tests of our "economic insecurity" hypothesis, and discuss some implications for consumer welfare and public policy.

Background and Theory

Cross-sectional studies of the demography of body weight in the developed world have repeatedly shown that obesity and overweight status disproportionately affect the poor (e.g., Chang and Lauderdale 2005). There are a number of plausible explanations for this, with causation potentially running in either direction: Higher body weights may lead to lower wages, either directly (via effects on physical mobility) or indirectly (via employment discrimination; see, e.g., Cawley 2004). Weight and income may be negatively correlated due to unobserved personal characteristics such as self-discipline or impulsivity (Cutler *et al.* 2003). And there might be pure income effects on economic decisions about health,[5] physical activity, and food consumption.[6]

But this coincidence of poverty with obesity is intriguing, in part, because—the aforementioned explanations notwithstanding—economic theory would seem to predict just the opposite. One thing about weight loss that everyone seems to agree on is that eating well and being physically active take <u>time</u>: it takes much less time to eat calorie-intensive fast food, for instance, than it does to consume freshly prepared meals, and it takes less time to travel by car than on foot. And if "being thin" is a time-intensive good, then we should expect those with the highest opportunity cost of time—i.e., those with high wages—to choose less of it. Moreover, this "time cost" theory of obesity has been borne out empirically, as a number of studies by economists have provided indirect evidence that the time cost of weight gain has driven the increase in obesity observed in recent decades: Cutler *et al.* (2003), for instance, emphasize the role of food processing technologies in reducing the time cost of food preparation; Lakdawalla and Philipson (2002) argue that Americans have gained weight in part because the workplace has become more sedentary (i.e., whereas much of the populace was effectively paid to exercise on the job a generation ago, today most jobs involve

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rapid technological change is emphasized by Smith (2004), Dasgupta and Maskin (2005), and Smith and Tasnádi (2007).

[5] A number of authors report a strong positive relationship between income and various measures of health (see, e.g., Marmot *et al*. 1991, Case *et al*. 2002, Deaton 2002). Sapolsky (2005) argues that physiologic responses to economic distress could plausibly generate many of the observed income-related health disparities.

[6] Reed *et al*. (2005), for instance, find positive income elasticities across a number of food purchase categories. Drewnowski (2004) argues that low-income households choose foods of low nutritional value in part because such foods are the most cost-effective source of calories.

nothing more strenuous than sitting at a desk); and Chou *et al*. (2004) point to the increasing prevalence of fast food restaurants as a key determinant of the observed trend.

Two Income Effects

It is possible, of course, that the opportunity cost of time does cause body weight to rise with income, while another income-related phenomenon works in the opposite direction. This brings us to the distinction between income and income security. As noted above, the primary biological function of body fat is its role as a form of precautionary savings. This would seem to suggest that in an optimal fattening framework, body fat should increase with both the *level* of currently available resources and with the *variability* of expected future resources. Consider the following two-period, two-state model: Suppose that a consumer lives for two periods, receives either high ($\breve{w}$) or low ($\widehat{w}$) income in each period, and chooses first-period consumption (c_1) and body fat (f_1) such that the sum of expected lifetime utilities is maximized. The consumer's first-period decision can be stated as:

$$\max_{c_1, f_1} u(c_1) + E(u(\tilde{w}_2 + \delta f_1)) \tag{1}$$

subject to

$$c_1 + f_1 \leq w_1$$

where w_1 is the realized income level in period 1, $\tilde{w}_2$ is a random variable representing income in period 2, and $\delta \in (0,1)$ is the factor by which metabolic energy depreciates when stored as body fat. If we assume further that the probability π_t of receiving the low-income payoff $\widehat{w}$ in period t is fixed but unknown, then the realized value of w_1 will have two distinct effects: it determines i) the size of the period 1 income constraint, and ii) it influences the consumer's subjective beliefs about the probability of receiving the low-income payoff in period 2. Moreover, if $u(\cdot)$ is increasing, continuously differentiable, and strictly concave, it is easy to show that these two "income effects" on body fat (f_1) work in opposite directions. Consider, for instance, the special case in which the probability of receiving $\widehat{w}$ is either π_{secure} or π_{insecure} ($\pi_{\text{secure}} < \pi_{\text{insecure}}$). Then the first-order conditions for (1) become:

$$u'(c_1) = P(w_2 = \widehat{w} \mid w_1)\delta u'(\widehat{w} + \delta f_1) + (1 - P(w_2 = \widehat{w} \mid w_1))\delta u'(\breve{w} + \delta f_1) \tag{2}$$

and

$$c_1 + f_1 = w_1 \tag{3}$$

where

$$P(w_2 = \widehat{w} \mid w_1 = \breve{w}) < P(w_2 = \widehat{w} \mid w_1 = \widehat{w}) \tag{4}$$

by Bayes's Rule.[7] Because comparative statics on (2) and (3) imply both that $\frac{\partial f_1}{\partial P(w_2 = \hat{w} \mid w_1)} > 0$ and that $\frac{\partial f_1}{\partial w_1} > 0$, (4) implies that the unambiguously positive effect of current income (w_1) on body fat (f_1) is offset by an unambiguously negative "income security" effect.[8]

In other words, low income today will make the consumer thinner (because less money is available for precautionary fattening) but it also makes him fatter (because it gives him reason to believe that low income is more likely tomorrow). At this level of abstraction, we cannot draw *a priori* conclusions about the relative magnitudes of these two effects with confidence, but the theory tells us that they will depend on the distribution of income payoffs and the degree of concavity in the utility function.

A Rational Psychology of Weight Gain

In addition to offering a fresh explanation for the negative association between income and body weight, we believe that a putative causal relationship between economic insecurity and body weight is worthy of further study for two reasons. First of all, as noted above, it has the appeal of a normative theory when viewed from the perspective of behavioral biology, and the rich literature in the realm of animal fattening overlaps with parallel studies of human obesity in

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[7] In particular, for arbitrary prior beliefs $P(\pi_1 = \pi_{\text{insecure}}) = (1 - P(\pi_1 = \pi_{\text{secure}})) = p$, $p \in (0,1)$, $P(w_2 = \hat{w} \mid w_1 = \breve{w}) = 1 - \frac{p(1-\pi_{\text{insecure}})^2 + (1-p)(1-\pi_{\text{secure}})^2}{p(1-\pi_{\text{insecure}}) + (1-p)(1-\pi_{\text{secure}})}$ and $P(w_2 = \hat{w} \mid w_1 = \hat{w}) = \frac{p\pi_{\text{insecure}}{}^2 + (1-p)\pi_{\text{secure}}{}^2}{p\pi_{\text{insecure}} + (1-p)\pi_{\text{secure}}}$. Expression (4) follows directly.

[8] The expressions for $\frac{\partial f_1}{\partial P(w_2 = \hat{w} \mid w_1)}$ and $\frac{\partial f_1}{\partial w_1}$ implied by the first-order conditions are:

$$\frac{\partial f_1}{\partial P(w_2 = \hat{w} \mid w_1)} = \frac{\delta\big(u'(\breve{w} + \delta f_1) - u'(\hat{w} + \delta f_1)\big)}{u''(c_1) + \delta^2 P(w_2 = \hat{w} \mid w_1)u''(\hat{w} + \delta f_1) + \delta^2(1 - P(w_2 = \hat{w} \mid w_1))u''(\breve{w} + \delta f_1)}$$

and $\frac{\partial f_1}{\partial w_1} = \frac{u''(c_1)}{u''(c_1) + \delta^2 P(w_2 = \hat{w} \mid w_1)u''(\hat{w} + \delta f_1) + \delta^2(1 - P(w_2 = \hat{w} \mid w_1))u''(\breve{w} + \delta f_1)}$. Both are positive by concavity of $u(\cdot)$. The latter expression is, of course, not precisely the "time cost" effect discussed in the literature; this would be more akin to examining the effects of the changes in the parameter δ (which can be interpreted as the "price" of body fat). Under the conditions we specify, however, the sign of $\frac{\partial f_1}{\partial \delta}$ is ambiguous, with an unambiguously positive substitution effect and an offsetting (unambiguously negative) income effect. Assuming the substitution effect dominates, the time-cost prediction that body fat will increase when the "price" of being thin rises (i.e., the value of δ rises) is borne out.

intriguing ways.[9] And while caution should always be exercised when applying a naturalistic model to human behavior, it is widely accepted that modern obesity is somehow related to the fact that much of human evolutionary history has been characterized by caloric scarcity.

But perhaps more importantly, our hypothesis about the relationship between economic stressors and weight gain is consistent with what is known about the psychology of exercise and diet. Nutritionists, for instance, often refer to "stress-induced eating" and "comfort foods" when exploring the personal reasons for excessive body weight (Greeno and Wing 1994, Dallman *et al*. 2003). And certain types of depression—notably seasonal disorders triggered by annual fluctuations in the length of the day—are associated with weight gain, in ways that mimic the behavior of animals faced with imminent starvation (Madden *et al*. 1996).

There is also the ubiquitous "self-control problem" suffered by just about anyone who has attempted to lose weight. The relationship between self-control and economic uncertainty (or "default risk") is direct. Self-control is typically modeled in economics as a time inconsistency problem, in which the decision-maker applies a declining rate of discount to future outcomes (e.g., Laibson 1997), and as a result perpetually makes choices that seem (in retrospect) to be regrettable and contrary to his long term well-being. This, of course, is exactly how one might describe the behavior of an individual who receives an uninterrupted stream of income over time (e.g., a series of $\breve{w}$ outcomes in a multi-period extension of the model developed above) that he believes to be at risk: he would experience perpetual regret at his over-reaction to perceived risk, and as he updates his beliefs about the likelihood of default (e.g., a $\widehat{w}$ outcome), this "excessive discounting" problem would diminish.[10,11] Translated into the terminology of diet: we should expect people to overeat when faced with economic insecurity. Moreover, this view of the psychology of self-control would suggest that one side-effect of mechanisms that "cushion the blow" of catastrophic income loss (by providing, for example, event-contingent payments) should have a corresponding *negative* effect

[9] To note but one area in which this is true, nearly every gene and molecular signal known to govern energy homeostasis and metabolism in mice has been shown to have a homologous counterpart in humans (Barsh *et al*. 2000).

[10] See Sozou (1998) and Dasgupta and Maskin (2005) for alternative formulations.

[11] A natural corollary to this observation is that if the risk is real, apparent time inconsistencies need not be indicative of a self-control *problem*. A surprisingly high proportion of U.S. households do appear to suffer more from risk than from lack of self-control: some 11.2% report being "food insecure," defined as being (at least) occasionally worried about having enough money to buy food (Nord *et al*. 2004). A number of authors have reported positive associations between food insecurity and overweight status in women (Olson 1999, Townsend *et al*. 2001, Basiotis and Lino 2002, Gibson 2003, Wilde and Peterman 2006).

on body weight.[12] In a sense, then, the empirical results we report below constitute a test of an endogenous theory of self-control.

An important clarification is in order at the outset. Our aim is to measure the extent to which economic insecurity causes weight gain. While our estimation strategy will control for the problems of reverse causation, unobservable personal characteristics, and income effects discussed above, our analysis will not (due to limitations in the data we employ) allow us to distinguish between intermediate mechanisms via which weight gain might occur. It might be, for instance, that the economically insecure react to economic stressors (or lack thereof) by altering either the quantity or the quality of their diet. Or it might be that economic insecurity makes people depressed and therefore inactive, as if "economic insecurity" and "physical activity" were economic substitutes. Or it might be that the psychology of economic insecurity simply induces a lower metabolic rate in those who experience it. Distinguishing between these alternatives is a question we leave for future research.

Empirical Approach

Our analysis employs individual-level data from the National Longitudinal Survey of Youth, 1979 Cohort (NLSY79). The NLSY79 is a longitudinal survey that follows individuals born in the same cohort (born 1957-1964) over a number of years. The longitudinal nature of this survey allows us to examine the relationship between changes in body weight over a 12-year period (ending in 2000) and one's personal experience with economic insecurity. We expect that the primary determinants of weight change over this period will include both the respondent's current (year 2000) circumstance (marital status, income, education, etc.) and his subjective beliefs about the probability of catastrophic income loss. Thus the inclusion of historical information in our suite of explanatory variables is motivated not by an explicitly dynamic theory of weight gain,[13] but rather by a

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[12] The negative effect of contingent payments on body weight is implied by our model because

$$\frac{\partial f_1}{\partial \hat{w}} = \frac{-\delta P(w_2 = \hat{w} \mid w_1) u''(\hat{w} + \delta f_1)}{u''(c_1) + \delta^2 P(w_2 = \hat{w} \mid w_1) u''(\hat{w} + \delta f_1) + \delta^2 (1 - P(w_2 = \hat{w} \mid w_1)) u''(\breve{w} + \delta f_1)} < 0.$$

[13] A dynamic specification might be called for, for instance, if many months or years were required to adjust one's weight to a new optimal level, or if the long-term health impacts of weight gain were an important determinant of body weight. Since we focus instead on the effects of prospective (and potentially imminent) income loss, dynamic effects—if empirically important—could affect the error structure in Equation (5). We believe it unlikely that dynamic effects are important, however, because the barriers to rapid weight gain/loss appear to be more psychological than physiological (in other words, there is no physical reason the human central nervous system couldn't accommodate rapid changes in weight), and because the long-term health effects of excessive body weight are unlikely to have been important in the pre-industrial world in which humans evolved.

desire to capture variation in perceived financial or economic insecurity. Our specifications are thus of the form

$$W_{2000,ij} = W_{1988,ij}\alpha + X_{2000,ij}\beta + S_{ij}\gamma + \eta_j + \sigma_{ij} \quad (5)$$

where W_{tij} is individual i's weight in year *t*, $X_{2000,ij}$ is a vector of individual i's personal characteristics in the year 2000, and S_{ij} is a proxy for individual i's subjective beliefs about his personal economic security. η_j represents a regional fixed effect, and σ_{ij} is a disturbance term. Robust standard errors are adjusted for an arbitrary within-state correlation pattern because many of the instruments are measured at the state level.[14]

Our primary concern with this specification is the potential for bias induced by the related problems of reverse causation and unobserved personal characteristics (that could be correlated with weight gain). We would like to use an individual's employment history, for instance, as a proxy for his beliefs about the probability of unexpected job loss. But if heavier people are more likely to become unemployed (independent of their beliefs about risk), then estimation of (5) by ordinary least squares (OLS) will generate upward-biased estimates of g .

This problem is partly (but not completely) ameliorated by the fact that we include weight in 1988 as a control variable. This is equivalent to controlling directly for unobservable permanent and pre-1988 personal characteristics (including genetic background, childhood experience, and early employment and educational history) that might affect weight. But in considering the effect on body weight of life events that occurred after 1988, we still must take care to measure only those events that are arguably exogenous. In considering an individual report of job loss, for example, the loss may be due to (i) unobserved personal characteristics (e.g., personality traits—like discipline—associated with both poor performance on the job and weight), or (ii) because of employment discrimination on the part of the employer (e.g., because the individual has recently gained weight), or (iii) because of a downturn in the local economy. Because we are interested in whether (and to what extent) events like job loss *cause* weight gain, we would like to exclude events of the first two types from our analysis.

For this reason, we employ an instrumental variables (IV) estimation strategy, in which our proxy for economic insecurity (and other variables of interest that are influenced by individual choices, like smoking and household income) is first regressed on observed personal characteristics and exogenous state- or MSA-level instruments. In the second stage, weight gain is regressed on a vector of personal characteristics and the *predicted* values of our proxy for economic insecurity from

[14] In practice, this was implemented using Stata's *cluster* command, with clustering by state.

the first stage. This is, of course, the statistical equivalent of establishing exclusion rules in medical research.

To ensure that our instruments will not be correlated with unobserved personal characteristics, we use primarily state-level variables for this purpose, and whenever possible we have chosen policy variables set by state legislatures. Our instruments are as follows: To identify the causal effect of income and wages on weight gain, we use state median household income from the US Census and the legal minimum wage in the state, respectively, as instruments.[15] To identify the effect of unemployment experience between 1988 and 2000, we use the series of annual BLS unemployment rates in the geographic areas where the individual resided. These are either the unemployment rate in the metropolitan statistical area (MSA) or the unemployment rate associated with the rural parts of the state, depending on where the individual lived in each year. For payments from government social services programs, we use the state maximum monthly welfare benefit for an eligible family of three, and for health insurance we use a vector of indicators of state-level regulations of the individual and small-group markets for health insurance that have been shown to influence health insurance prices.[16] To identify a causal effect of smoking, we follow the approach of Gruber and Frakes (2006) and use state cigarette taxes.[17] For various measures of fluctuations in annual household income, we construct state-level averages and median values directly from the NLSY79 data (pooling both men and women).[18]

With all of these state-level policy variables, the implicit identifying assumption is that while the state policy may affect the individual attribute of interest (income, transfer payments, insurance status, smoking, etc.), the state

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[15] Note that the effect of minimum wages on income may be ambiguous. Minimum wages may increase incomes for minimum wage workers but may also increase unemployment. Either way, to the degree that the minimum wage can predict income without being correlated with an individual's weight, it is a valid instrument.

[16] See Congdon, William, Kowalski and Showalter (2005) for evidence on the connection between state regulations and health insurance prices.

[17] Using cigarette prices instead of taxes, following Chou *et al*. (2004), produces similar results.

[18] Instruments for income volatility based on data averages may not fully solve the identification problem. For example, suppose that "laziness" is an omitted characteristic that is correlated with both the likelihood that an individual experiences an income drop and with weight gain. If the state average for income drops is high because many people in that state are lazy, this approach will not resolve the identification problem. If the average is more reflective of overall state economic conditions, then this instrument is more likely to be valid. We therefore encourage more caution in interpreting these results than with the results for health insurance, for example, where the state policy is more clearly exogenous.

policy variable has no independent effect on weight after controlling for these individual characteristics. Furthermore, individuals' weights in a state are assumed not to affect the state policies. All of these instruments appear to be highly correlated with the endogenous variables of interest, with F-statistics of the joint significance of the instruments in the first stage ranging from about 9 to 20. Because many of our equations are overidentified (for example, there are four health insurance state policies that instrument for health insurance status), we use a Generalized Method of Moments (GMM) estimator in the IV analyses.[19]

Data

We focus on the years 1988-2000, when all participants are older than 23 and had mostly completed their formal education. The longitudinal nature of the survey allows for long-range measures of individual economic variables (like unemployment in the past, as well as employment status at the time the survey was administered), and it allows for an examination of individual weight changes rather than simply differences in weight levels across individuals. The NLSY79 survey also includes data on other behaviors like smoking.

We exclude women from our analysis for three reasons. First, labor supply decisions for men are more uniform than those of women, particularly as our sample is ages 23-42, prime childbearing years. Second, body weight in women may be partly related to fertility decisions, and these decisions are also likely to be related to economic variables. Third, the economic security of women in the NLSY79 cohort is more dependent on spousal income than it is for men, and spouse-level indicators of economic insecurity are not reported as comprehensively in NLSY79 as the individual-level indicators we utilize.[20]

The analysis also uses a number of other state-level variables. These data include unemployment rates, median income, maximum welfare benefits for a family of three, and state health insurance regulations. Sources for each of these variables are listed in the Data Appendix.

Our data include three different measures of income security. The first is the individual's Bayesian posterior probability of unemployment. This probability was calculated from weekly data on employment status available in NLSY79, based on a five-year (1996-2000) career horizon with prior distributions generated

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[19] See Davidson and MacKinnon (1993) for a discussion of this estimator.

[20] Though we do not report them here, we did replicate the results presented in Tables 2 through 4 below for females in the NLSY79 cohort. In general, the results for women are broadly similar to what we find for men, though—as might be expected, given the concerns discussed above—the magnitudes of most insecurity-related coefficients are smaller, and standard errors larger.

from the full sample of NLSY79 men (see Data Appendix for details).[21] We hypothesize that individuals who face higher probabilities of future unemployment (as measured by their past experience) will gain more weight.

The second set of measures for insecurity proxy for the rate of change and volatility implicit in the individual's history of reported annual income. These measures are the slope and R^2 from linear regressions of family income on a time trend, with a separate regression for each individual. The slope coefficient of the regression (or "Rate of Change") gives the individual's typical annual increase in income from 1988 to 2000. This annual increase may measure anticipated and predictable changes in income. The R^2 (or "Goodness of Fit") is a measure of deviations from a linear trend, and therefore how much uncertainty an individual has faced. Individuals with low R^2 will have experienced an income stream that is either highly volatile or highly non-linear, and thus would be likely to consider current (year 2000) and future income to be more at-risk. Note that this measure is likely to be affected not only by an individual's employment history, but also by any changes in hours or wages, and changes in other components of household income, such as spousal employment.

Unexpected positive shocks to income might affect weight differently than negative shocks. The third measure of insecurity therefore measures the number of drops in real annual household income that an individual experienced from 1988 to 2000. Again, individuals with more drops in household income, for whatever reason, are likely to have higher perceived levels of economic insecurity and thus we expect them to experience higher weight gains.

We also have three measures of "safety nets" that could serve the purpose of providing a source of income during periods of catastrophic income loss. The first is inheritance payments due to the death of a friend or family member in 2000. This measure is arguably exogenous, because a friend or relative's death is arguably an exogenous event. We also examine health insurance status as another indicator of greater economic security, with state regulations that affect health insurance prices as the identifying instruments. Finally, we examine the effect of total government transfer payments, which may act as a social safety net that mitigates economic insecurity. These transfer payment include TANF payments, food stamps, social security insurance, unemployment insurance, and other public assistance payments. As noted above, the identifying instrument for this variable is the state legislated maximum benefits for a family of three.

The means and standard deviations of all variables are reported in Tables 1a and 1b. On average, men in our sample weighed 177 pounds in 1988, and 198 pounds in 2000 (for an average 12-year gain of 21 pounds). Table 1a indicates that on the day the survey was administered in 2000, 2.6% of men in the sample

[21] The posteriors are based on a five year horizon because the median tenure with a given employer is about four years for the NLSY sample. (Mean tenure is about six years.) A five year window is therefore limited to a period over which the "hazard rate" associated with employment status can be presumed to remain relatively constant.

were unemployed, and 11.8% were unemployed at some point during the year. The average (posterior) probability of unemployment in 2000 was 2.6%. Individuals in the sample experienced on average 2.1 drops in reported real annual income between 1988 and 2000, and the average R^2 from individual-specific regressions of income on time was about 0.6. On average, individuals received about $2,200 in inheritance payments (non-recipients coded as zero). 84% of individuals in our sample were covered by health insurance at the time of the 2000 survey. Unconditional average (non-recipients coded as zero) transfer payments (including AFDC payments, food stamps, social security insurance, and other public assistance payments) received in 2000 was $195.73. Means of other variables included in the regressions (age, family income, height, race, marital status, education, etc.) are presented in Table 1a.

Results

Income and Wages

Before examining the effects of insecurity on weight gain, we first examine the correlation between income and weight gain in our sample. The results presented in Table 2 show the effect of income, wage rate, and current unemployment on weight gain. In this table and succeeding tables, we present a column of OLS results followed by the IV estimates. In general, we have found that our state- or MSA-level instruments are highly significant and have the expected signs in the first stage regressions, with exceptions noted below. For brevity, we have not presented first-stage results, but they are available from the authors on request.

These regressions all include weight in 1988 as a control variable. In most specifications, the coefficient on weight in 1988 cannot be statistically distinguished from 1. As a result, the coefficients on the other variables of interest can be interpreted as indicating the effect of the variable on the weight gain over the 1988 to 2000 period.[22]

The OLS results in column 1 show that the estimated effect of income on weight change is negative (though not statistically significant), but in the IV specification it is positive, suggesting that (to the extent that there is a causal effect of income on weight) being poor makes people thinner, not fatter.[23] We then ask

[22] Because many surveys do not include data on long-term changes in body weight, we replicated all specifications with 1988 weight omitted. The estimated coefficients in these regressions (which we do not report) are very similar to those reported in Tables 2 through 4 below, but the standard errors are much larger.

[23] We also tested for a nonlinear effect of income on body weight by expanding this specification to include the square of annual income, and found this second-order effect to be negative but not statistically significant. Moreover, the magnitude of the nonlinear

(in columns 3-6) whether this positive income effect is driven by variation in the opportunity cost of time, and find strong evidence that it is. In columns 3 and 4, we include hourly wage as an endogenous regressor, and find that (in the IV specification of column 4), a $1 increase in hourly wage results in an additional 0.34 pounds in body weight gained over this period.

Hourly wages used in columns 3-4 are derived from annual wage income and annual hours worked, and are therefore not available for those who have been unemployed all year. These estimates therefore exclude such individuals. Estimates of the effects of current unemployment are presented in columns 5 and 6.[24] We distinguish between unemployment "anytime this year" and unemployment "on the day of the survey" because we expect to observe a strong distinction in the effects of these two variables on body weight: while the latter is indicative of an individual with an opportunity cost of time of approximately zero (which should dramatically affect decisions about diet and exercise), the former indicates an individual who may not currently be unemployed, but faces a high risk of becoming unemployed. Although we instrument for unemployment "anytime this year" in the IV specifications, we treat "unemployed at time of survey" responses as exogenous, as the particular day on which a person was interviewed should not be related to unobserved personal characteristics. Again, the time cost prediction is borne out: though estimated imprecisely $(p = 0.31)$, being currently unemployed at the time of the survey in 2000 is associated with a 7-pound *decrease* in weight gained.[25] But the strong positive (17-pound) effect of "anytime in 2000" unemployment status is suggestive of another effect of unemployment: the risk of becoming unemployed appears to cause an *increase* in weight gained. We now turn our attention to this "economic insecurity" aspect of unemployment.

Economic Insecurity

Table 3 shows the effect of the three different measures of economic insecurity on weight gains between 1988 and 2000. The first two columns control for economic insecurity by including the Bayesian probability of unemployment,

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effect was exceedingly small, such that the marginal effect of income on weight gain remains positive until annual income exceeds $600,000 (which is nearly double the maximum income reported in our sample). These results are not reported in Table 2, but are available from the authors upon request.

[24] Including measures of unemployment, wages, and income together creates problems with collinearity because wages are a derived measure in these data. For this reason, we control for annual income (but not wage) in these and all subsequent specifications. This also allows us to also include all of the unemployed in the analysis.

[25] This is consistent with reports by Ruhm (2000, 2005) that periods of low employment in the U.S. have historically been associated with decreases in body weight.

derived from the individual's past unemployment experience. The IV results presented in Column 2 indicate that a 1% increase in the probability of becoming unemployed causes an increase in body weight of just over one pound.[26] We use the Bayesian posterior in order to capture the individual's anticipated future risk of unemployment that drives their weight gain. However, in unreported specifications, we also find that using the number of weeks unemployed over the past five years yields similar results. Using longer windows of time attenuates the results, as might be expected if unemployment experience in the distant past are less predictive of future spells of unemployment.

The next two columns use measures of the rate of change and "noise" implicit in the individual's history of reported annual income. Note that in the IV specification reported in Column 4, an increase in "goodness of fit" (equivalent to R^2 in least-squares regression analysis) by 0.1 units corresponds to a decrease in body weight of 2.9 pounds. This is consistent with the hypothesis that individuals with more volatile streams of income anticipate future income insecurity, and respond by gaining weight.

The final two columns use an alternative (and much simpler) measure of the insecurity associated with this same annual income stream: the number of drops in reported annual income from one survey to the next. Again, economic insecurity seems to generate weight gain: in the IV estimates, for each additional year in which real income drops, the typical individual in our sample gains 5.5 pounds.

Perhaps it is also worth noting that coefficients on other variables in Table 3 are consistent with the economic insecurity hypothesis. Being black or Hispanic is associated with (statistically significant) weight gains; and smoking appears to induce weight loss. The consistent and strong results on race and ethnicity are interesting because they admit a number of possible alternative explanations: it could be that blacks and Hispanics are subject to employment discrimination (and hence are faced, on average, with higher levels of economic insecurity than white non-Hispanic men); it could be that genetic differences between racial and ethnic groups generate differences in weight gain; or there could be other unobserved traits or characteristics (e.g., culturally derived differences in dietary quality) associated with these groups that are also associated with weight gain. The negative effect of smoking on weight gain is interesting because it has been noted that the nicotine in cigarettes appears to target the same systems in the human brain that are stimulated by indicators of economic security, and that smoking might be properly thought of as a "self-medicating" response to economic insecurity.[27] That smoking would cause weight loss is consistent with this hypothesis.

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[26] Recall the instruments here are the set of unemployment rates in the areas the individual is reported to have lived between 1988 and 2000.

[27] Evidence for this tobacco-insecurity hypothesis is outlined in Pomerleau (1997) and Smith (2006).

Note also that higher levels of education, though (being a personal choice) potentially endogenous, appear to be associated with lower levels of weight gain. It is possible, of course, that education promotes weight loss for other reasons (e.g., better knowledge of nutrition science), but these results could also be interpreted as supportive of the hypothesis that education influences body weight by improving economic security (e.g., by enabling individuals to adapt to job changes and other shocks to economic security).

Public and Private Safety Nets

Given that catastrophic income loss causes weight gain, one might expect that measures that "cushion the blow" would ameliorate insecurity-induced weight gains. Table 4 considers three examples of "safety nets" that could serve this purpose.

In the first two columns, we examine the effect of the size of payments received (via inheritance)[28] due to the death of a friend or family member in 2000, and find small (just over 3 pounds per $100,000 received) but statistically significant negative effects on weight gain.

Health insurance is another means by which individuals can be protected from large negative income shocks. Because health insurance is often purchased on the individual market or is contingent upon employment, it is subject to the well-known *adverse selection* problem: because healthier individuals are less likely to need health insurance, they are less likely (at a given price) to purchase it. On the other hand, health insurance can also induce a *moral hazard* problem: given the presence of insurance, individuals might invest less time or money in health-promoting preventive measures (such as active weight loss) that might decrease the demand for medical services in the future (Rothschild and Stiglitz 1976). Our IV estimation strategy should eliminate the adverse selection problem. Our estimate of the effect of health insurance on weight (using various state-level measures of regulation of insurance markets that affect the price of health insurance as instruments) can thus be interpreted as the net effect of two opposing forces: weight *loss* due to improved financial security, offset by weight *gain* induced by moral hazard. As the fourth column in Table 4 indicates, the security effect dominates, by more than 15 pounds. Adverse selection (healthy individuals opting out of the insurance market) also seems to be important and affects our estimates in the expected direction, as evidenced by the 17-pound difference between our OLS and IV estimates.

A similar effect is seen for total government transfer payments received, and again the marginal impact on weight gain is large. The OLS estimate of the effect of government transfer payments is positive, indicating that transfer recipients had a slightly larger weight gain, even controlling for income. Of course, individuals who receive transfer payments are likely to have many omitted personal

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[28] Inheritance is treated as an exogenous variable in all specifications.

characteristics that may also affect their weight, and this OLS estimate cannot indicate the causal effect of a more generous social insurance program. However, the IV estimate of the effect of government transfer payments (using state maximum benefits for a family of three as the instrument) indicates that an additional $100 of government benefits in 2000 is associated with a 1.2 pound *reduction* in weight gain. This is a large effect, possibly due to the fact that all government support is not measured. For instance, if more generous states also have more extensive support for child care, health care, or housing, this variable may capture the cumulative effect of all of these government support programs.

Implications for Consumer Welfare

The implications of weight gain for consumer welfare are not uncontroversial. If consumers freely choose how much to eat and how much to exercise, then (assuming complete markets) conventional welfare analysis would conclude that government intervention aimed at improving health through weight loss could not make people better off. Such analysis would suggest, moreover, that if the rise in obesity observed in recent decades has been driven by a concurrent rise in the opportunity cost of time, then obesity can actually be viewed as an *optimal* outcome, by the metric of economic efficiency (Chou, *et al*. 2004, Cutler *et al*. 2003). In other words, the fact that we are collectively fatter might be taken as a sign that we are collectively better off.[29]

Of course, if self-control problems are an important determinant of weight gain, it is no longer clear that efficiencies in the markets for food or labor translate into welfare gains.[30] But our findings suggest an entirely different perspective: if apparently time-inconsistent choices about diet and exercise are in fact natural responses to risk, then body weights will be excessive only to the extent that risk is excessive. And while a revamping of America's social safety net may be a novel solution to the modern obesity epidemic, many threats to economic security (job stability, availability of health care, etc.) are arguably a function of factors beyond the control of the individual consumer. It might be appropriate, then, to recast this

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[29] One commonly cited "market failure" associated with obesity is the above-mentioned moral hazard problem (e.g., Bhattacharya and Sood 2005). To the extent that health insurance is inducing weight gain, public expenditures to promote weight loss might be justified on efficiency grounds. Our results suggest, however, that the net effect of health insurance on weight is negative.

[30] Cutler *et al*. (2003), for instance, argue that if self-control problems are strong enough, they could more than offset efficiency gains made elsewhere. They also note, however, that—measured in the currency of time cost—the 20-minute decrease in the amount of time required for daily food preparation realized in the last few decades more than offsets the 15 minutes of exercise that would be required to offset the gains in weight observed over the same time period.

debate over the putative impact of obesity on consumer welfare as a discussion of the welfare effects of economic insecurity. Indeed, if the proportion of the modern obesity epidemic attributable to economic insecurity could be reliably estimated,[31] the cost of the associated weight gain could provide a lower bound on the social cost of risk in the marketplace.[32]

It is perhaps also worth noting that economic insecurity—regardless of its impact on consumer welfare—is difficult to measure. It requires data that can speak to future expectations, perhaps (as our constructs assume) as revealed by life experience. In this respect, our findings might offer some hope: In principle, one could use weight gain (after controlling for other possible causes) as a barometer of economic insecurity.

Conclusion

There can be no real individual freedom in the presence of economic insecurity.
--Chester Bowles, US diplomat & economist (1901-1986)

In the natural world, body fat serves as an insurance plan, and animals at greater risk of starvation are more likely to gain weight. This phenomenon has received little attention in the study of human obesity, and (perhaps as a result) epidemiological studies have often conflated the effects of income, time costs, and economic insecurity, and have not always accounted for potential reverse causation or unobserved individual characteristics.

Our results provide strong evidence that economic insecurity does in fact cause weight gain. Each of three measures of economic insecurity (probability of unemployment, volatility of income, and number of income drops) generate weight gains, with magnitudes that are considerable relative to the overall increase in weight observed over a 12 year period. While the mean respondent gained 21 pounds over our 12-year window, for instance, a decrease of one standard deviation in our various measures of economic insecurity corresponds to a decrease in weight gain ranging from 5 to 13 pounds. We also find that private windfalls (as measured by a reported inheritance), health insurance, and social

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[31] While our analysis provides estimates of the magnitude of the impact of selected measures of insecurity on weight gain, the limited size of our sample precludes us from simultaneously estimating, for example, the relative impacts of food price and availability. Moreover, our data is longitudinal and thus cannot speak to demographic changes in the population.

[32] Such costs would arguably include not just the cost of lost productivity and medical treatment for obesity-related illness (which in 2001 reportedly added up to $117 billion in the U.S. [U.S. Department of Health and Human Services 2001]), but also associated consumer expenditures on food.

insurance (government transfers) lead to decreases in weight gains, and again the effect is large: an increase of one standard deviation in support provided by financial safety nets leads to decreased weight gains of between 1 and 14 pounds.

As noted at the outset, this study does not attempt to address the proximate mechanisms (presumably some combination of the quality or quantity of food consumed, physical activity, and metabolic rate) by which economic insecurity leads to weight gain. These proximate mechanisms have been the primary focus of the epidemiological research on obesity, and a major implication of our findings is that without a better understanding of the ultimate *causes* of each mechanism (presumably some combination of information sets and material constraints), the potential for misinterpretation in obesity research is great. In particular, studies that measure associations between body weight and the proximate mechanisms (e.g., depression, poor dietary quality, physical exercise) by which economic insecurity might drive weight gain could suffer—if they fail to properly control for insecurity—from omitted variables bias. Needless to say, such errors of omission could also limit the utility of such studies for informing the public policy response to the modern obesity epidemic.

There is also the question of the cause of the recent increase in the incidence of obesity in the U.S. and around the world. Unfortunately, the measures of economic insecurity available to us in this study are not easily recovered from historical data, making it difficult for us to estimate how much of the observed secular trend might be attributable to changes in economic insecurity. Nevertheless, for at least one of our variables we can perform a "back of the envelope" calculation to obtain a measure of the potential contribution of changes in insecurity to the overall trend. Between 1979 and 2001, the prevalence of health insurance among U.S. workers decreased by about eight percentage points (Gilmer and Kronick 2005). During roughly the same period, the average body weight of men aged 30-39 (i.e., working age men young enough to be unaffected by changes in retirement security) increased by 13.6 pounds (Ogden *et al*. 2004). Using our estimate of the effect of health insurance on body weight, the observed decrease in health coverage translates into a population average weight gain of 1.2 pounds. In other words, *changes in health insurance markets alone* could potentially account for nearly 9% of the observed trend in body weight. It is also worth noting that some commentators have argued that—over the same thirty years or so in which obesity has risen so dramatically—there has been a concurrent increase in the degree to which individual households in the U.S. are exposed to other types of financial risk.[33]

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[33] See, for example, Neumark (2000) on the rate of involuntary job loss and Hacker (2004, 2006) for discussions of the change from defined-benefit pensions to individual 401(k) accounts. Auld and Powell (2006) also note that Canada—a country with an arguably stronger social safety net—has an obesity rate that is 7 percentage points lower than the US rate, with at most 1/3 of the difference attributable to demographic differences.

The relationship between economic insecurity and weight gain bears all the hallmarks of an evolutionary adaptation: it has strong parallels in studies of animal behavior; it is evidently governed by behavioral algorithms written into our DNA; and it is associated with behaviors commonly perceived as "emotional" rather than "rational," as these terms are understood in common usage. Moreover, a "fattening response" to the presence of economic insecurity would appear to be more appropriate in a pre-industrial world—in which the food supply was far less stable—than it is today. But the question of whether such behavior remains "optimal" in the modern world is beside the point. The fact that economic insecurity appears to be an important cause of weight gain in the U.S. today suggests the need for additional research that will improve our understanding of both the various ways in which the income of American families is at risk, and the particular ways in which such risk is translated into weight gain.

Tables and Figures

Table 1a: Means and Standard Deviations of Individual and State Characteristics
NLSY Men

Characteristic	Mean	Standard Deviation
Family income (in $1000) in 2000	57.417	53.242
Family income (in $1000) squared in 2000	6130	16055
Hourly Wage in 2000	20.993	60.412
Unemployed at time of survey in 2000	0.026	0.160
Unemployed any time in 2000	0.118	0.323
Posterior probability of unemployment, 2000	0.026	0.077
Annual income: Rate of Change (slope), 1988-2000	2.925	2.726
Annual income: Goodness of Fit (R^2), 1988-2000	0.575	0.320
Number of Drops in Real Family Income, 1988-2000	2.13	1.247
Total value of inheritance (in $1000)	2.209	21.671
Government transfer payments received in 2000 (in $1000)	0.194	1.173
Covered by Health Insurance, 2000	0.836	0.37
Currently smoke, 2000	0.31	0.462
Weight (in lbs) in 1988	176.552	31.884
Weight (in lbs) in 1988	176.552	31.884
Weight (in lbs) in 2000	197.508	39.035
Change in Weight, 1988-2000	20.991	23.0165
Height (in inches)	69.66	2.587
Height (in inches) squared	4859.283	358.7407
Age in 2000	38.865	2.267
Black	0.275	0.446
Hispanic	0.184	0.387
White	0.542	0.498
Married in 2000	0.608	0.488
Never Married by 2000	0.205	0.404
Divorce or separated by 2000	0.183	0.387
Widowed by 2000	0.003	0.06
BA	0.220	0.415
Some college	0.216	0.411
High school graduate	0.445	0.497
High school dropout	0.119	0.323
Live within a metropolitan area in 2000	0.066	0.249

Sources: See Data Appendix.

Table 1b: Means and Standard Deviations of State Characteristics
NLSY79, various years

Characteristic	Mean	Standard Deviation
Unemployment rate in local labor market, 1988	6.325	2.597
Unemployment rate in local labor market, 1989	5.535	2.077
Unemployment rate in local labor market, 1990	5.673	1.965
Unemployment rate in local labor market, 1991	73.836	27.415
Unemployment rate in local labor market, 1992	8.014	2.5
Unemployment rate in local labor market, 1993	7.548	2.614
Unemployment rate in local labor market, 1994	7.129	2.687
Unemployment rate in local labor market, 1996	6.847	3.104
Unemployment rate in local labor market, 1998	5.103	2.81
Unemployment rate in local labor market, 2000	4.477	2.538
State cigarette tax (in cents), 1988	34.63	8.247
State cigarette tax (in cents), 1989	39.199	9.848
State cigarette tax (in cents), 1990	41.737	11.779
State cigarette tax (in cents), 1991	46.59	11.756
State cigarette tax (in cents), 1992	47.397	12.172
State cigarette tax (in cents), 1993	54.021	14.426
State cigarette tax (in cents), 1994	56.65	17.461
State cigarette tax (in cents), 1996	58.067	19.35
State cigarette tax (in cents), 1998	60.561	21.979
State cigarette tax (in cents), 2000	79.027	30.678
Median household income, 2000	42571.05	5289.083
Maximum welfare benefits for family of 3, 2000	395.883	152.435
State minimum wage, 2000	5.284	0.31
Mean State Annual income: Goodness of Fit (R^2), 1988-2000	0.548	0.041
Median State Annual income: Goodness of Fit (R^2), 1988-2000	0.609	0.075
Mean State Annual income: Rate of Change (slope), 1988-2000	2.761	0.372
Median State Annual income: Rate of Change (slope), 1988-2000	2.35	0.395
Mean State Number of Drops in Real Family Income, 1988-2000	2.067	0.143
State Health Insurance Regulation: Plan Liability, 2000	0.257	0.437
State Small Group Health Insurance Regulation: No. of Mandates, 2000	31.126	9.247
State Small Group Health Insurance Regulation: NAIC Rating Bands, 2000	0.599	0.49
State Small Group Health Insurance Regulation: Tight Rating Bands, 2000	0.234	0.423
State Small Group Health Insurance Regulation: Community Rating, 2000	0.364	0.481
State Individual Health Insurance Regulation: Any Market Reform, 2000	0.24	0.427
State Individual Health Insurance Regulation: Guaranteed Issue, 2000	0.17	0.384

Sources: See Data Appendix

Table 2: Effect of Income, Wage and Current Unemployment on Body Weight in Men, 2000

Variables	OLS	IV	OLS	IV	OLS	IV
Family income (in $1000), 2000	-0.008	0.22***	-0.008	0.032	-0.006	0.115***
	(0.007)	(0.065)	(0.007)	(0.092)	(0.008)	(0.03)
Hourly Wage, 2000	--	--	0.003	0.336***	--	--
			(0.002)	(0.112)		
Unemployed at time of survey in 2000	--	--	--	--	0.301	-6.621
					(3.094)	(6.468)
Unemployed anytime in 2000	--	--	--	--	1.551	17.181**
					(1.635)	(7.533)
Currently Smoke, 2000	-4.367***	-13.676	-4.321***	-24.243***	-4.469***	-9.709*
	(1.057)	(10.552)	(1.206)	(8.621)	(1.062)	(5.559)
Weight in 1988 (in pounds)	0.968***	0.949***	0.968***	0.948***	0.968***	0.965***
	(0.02)	(0.022)	(0.022)	(0.025)	(0.02)	(0.015)
Height (in inches)	4.532	0.981	-0.47	-2.268	4.604	4.995
	(5.382)	(4.958)	(5.343)	(5.752)	(5.352)	(4.012)
Height (in inches) squared	-0.026	0	0.01	0.025	-0.026	-0.03
	(0.039)	(0.036)	(0.039)	(0.043)	(0.039)	(0.03)
Age	-0.727***	-0.849***	-0.868***	-0.786**	-0.729***	-0.906***
	(0.158)	(0.15)	(0.171)	(0.315)	(0.157)	(0.103)
Black	8.255***	9.848***	8.421***	9.642***	8.153***	8.019***
	(1.142)	(1.179)	(1.188)	(1.093)	(1.172)	(0.85)
Hispanic	3.422***	3.107***	2.42**	3.55**	3.357***	2.026***
	(1.177)	(1.202)	(1.164)	(1.43)	(1.190)	(0.782)
Married	1.439	-8.195**	1.576	-4.465	1.527	-2.651*
	(1.295)	(3.337)	(1.323)	(3.006)	(1.284)	(1.534)
Divorced or Separated	-1.82	-3.884***	-1.372	-2.535**	-1.768	-2.74**
	(1.476)	(1.365)	(1.546)	(1.257)	(1.443)	(1.072)
Widow	-3.859	5.919	-5.743	1.73	-3.846	3.859
	(13.715)	(9.995)	(17.873)	(15.304)	(13.854)	(9.561)
BA Degree	-2.442	-18.019**	-1.763	-20.995***	-2.348	-8.619**
	(1.816)	(8.041)	(1.726)	(6.98)	(1.809)	(3.637)
Some College	-1.042	-7.985*	0.135	-10.008***	-0.965	-2.678
	(1.756)	(4.333)	(1.687)	(3.852)	(1.744)	(2.316)
High School Graduate	0.521	-3.032	1.198	-4.858**	0.615	-0.183
	(1.671)	(2.561)	(1.791)	(2.384)	(1.647)	(1.462)
Live Within a Metropolitan Area	-0.523	2.539	-1.72	-0.644	-0.544	1.883
	(1.935)	(1.811)	(1.960)	(1.734)	(1.907)	(1.278)
N	2813	2605	2575	2403	2813	2552
R^2	0.67	0.591	0.68	0.324	0.67	0.641

Sources: See Data Appendix
Variables are for the year 2000, unless otherwise specified
Robust standard errors (adjusted for within-state clustering) in parentheses.
* significant at 10%, ** significant at 5%, *** significant at 1%

Table 3: Effect of Economic Insecurity on Body Weight in Men, 2000

Variables	OLS	IV	OLS	IV	OLS	IV
Family income (in $1000)	-0.005	0.131**	-0.012	-0.069	-0.008	0.097**
	(0.008)	(0.032)	(0.009)	(0.07)	(0.008)	(0.042)
Posterior probability of unemployment	13.244	112.918**	--	--	--	--
	(8.277)	(22.76)				
Annual income: Rate of Change (slope), 1988-2000	--	--	0.211	3.003	--	--
			(0.266)	(1.938)		
Annual income: Goodness of Fit (R^2), 1988-2000	--	--	-0.477	-29.4***	--	--
			(1.671)	(9.125)		
Number of Drops in Real Family Income, 1988-2000	--	--	--	--	-0.128	5.464***
					(0.337)	(1.726)
Currently Smoke	-4.559***	-3.614	-4.298***	-2.453	-4.351***	0.682
	(1.057)	(4.334)	(1.05)	(3.839)	(1.046)	(7.458)
Weight in 1988 (in pounds)	0.968***	0.969**	0.968***	0.996***	0.968***	0.989***
	(0.02)	(0.015)	(0.021)	(0.015)	(0.02)	(0.02)
Height (in inches)	4.655	4.517	3.534	2.715	4.483	7*
	(5.421)	(3.089)	(5.384)	(4.185)	(5.42)	(3.806)
Height (in inches) squared	-0.027	-0.027	-0.019	-0.014	-0.025	-0.046
	(0.039)	(0.023)	(0.039)	(0.031)	(0.039)	(0.028)
Age	-0.729***	-0.909**	-0.687***	-0.703***	-0.727***	-0.817***
	(0.157)	(0.138)	(0.166)	(0.116)	(0.158)	(0.109)
Black	7.922***	5.66**	8.258***	7.264***	8.233***	9.621***
	(1.207)	(0.728)	(1.134)	(0.514)	(1.125)	(0.731)
Hispanic	3.313***	1.656*	3.415***	3.304***	3.413***	3.588***
	(1.161)	(0.787)	(1.181)	(0.792)	(1.175)	(0.911)
Married	1.672	-1.718	1.133	2.044	1.452	-2.02
	(1.263)	(1.761)	(1.348)	(3.057)	(1.289)	(2.413)
Divorced or Separated	-1.674	-2.319	-1.928	-4.454***	-1.775	-5.329***
	(1.443)	(1.349)	(1.487)	(1.028)	(1.48)	(1.178)
Widow	-3.486	6.313	-4.057	-4.404	-3.859	-1.056
	(13.708)	(7.778)	(13.830)	(7.615)	(13.733)	(9.33)
BA Degree	-2.214	-5.539	-2.892	0.052	-2.473	-1.484
	(1.794)	(3.314)	(1.806)	(4.963)	(1.814)	(5.998)
Some College	-0.86	-0.731	-1.23	2.716	-1.044	0.278
	(1.722)	(1.94)	(1.735)	(3.089)	(1.761)	(3.238)
High School Graduate	0.69	0.757	0.38	2.509	0.513	1.366
	(1.638)	(1.313)	(1.643)	(2.032)	(1.671)	(2.082)
Live Within a Metropolitan Area	-0.6	1.833	-0.552	0.672	-0.505	0.989
	(1.955)	(1.38)	(1.97)	(1.318)	(1.933)	(1.488)
N	2813	2552	2772	2513	2813	2552
R^2	0.68	0.618	0.67	0.641	0.67	0.637

Sources: See Data Appendix
Variables are for the year 2000, unless otherwise specified
Robust standard errors (adjusted for within-state clustering) in parentheses.
*significant at 10%, ** significant at 5%, *** significant at 1%

Table 4: Effect of Financial Safety Nets on Body Weight in Men, 2000

Variables	OLS	IV	OLS	IV	OLS	IV
Family income	-0.006	0.129***	-0.006	0.092***	-0.004	0.118***
(in $1000)	(0.008)	(0.032)	(0.007)	(0.02)	(0.008)	(0.037)
Inheritance Received	-0.036***	-0.034***	--	--	--	--
(in $1000)	(0.01)	(0.008)				
Health Insurance	--	--	1.82	-15.031***	--	--
			(1.161)	(4.166)		
Government Transfer	--	--	--	--	0.499	-11.54***
Payments (in $1000)					(0.319)	(3.016)
Posterior Probability	13.254	111.064***	15.302*	60.951***	12.929	167.356***
of Unemployment	(8.275)	(22.725)	(8.727)	(20.9)	(8.483)	(39.828)
Currently Smoke	-4.603***	-2.87	-4.472***	1.166	-4.397***	2.336
	(1.055)	(4.285)	(1.06)	(3.048)	(1.11)	(6.495)
Weight in 1988 (in pounds)	0.968***	0.972***	0.967***	0.978***	0.968***	1.002***
	(0.02)	(0.015)	(0.02)	(0.011)	(0.02)	(0.017)
Height (in inches)	4.847	4.934	4.598	6.36**	4.471	5.28
	(5.404)	(3.062)	(5.388)	(3.104)	(5.395)	(3.518)
Height (in inches) squared	-0.028	-0.03	-0.026	-0.039*	-0.025	-0.033
	(0.039)	(0.023)	(0.039)	(0.022)	(0.039)	(0.026)
Age	-0.73***	-0.898***	-0.738***	-0.891***	-0.766***	-0.858***
	(0.158)	(0.139)	(0.16)	(0.08)	(0.157)	(0.137)
Black	7.851***	5.632***	7.956***	6.142***	7.669***	5.686***
	(1.196)	(0.706)	(1.195)	(0.677)	(1.226)	(1.423)
Hispanic	3.246***	1.694**	3.403***	2.454***	3.559***	1.9*
	(1.158)	(0.79)	(1.169)	(0.752)	(1.183)	(1.036)
Married	1.704	-1.452	1.348	1.957*	1.762	-1.769
	(1.267)	(1.774)	(1.308)	(1.045)	(1.184)	(2.294)
Divorced or Separated	-1.623	-2.266*	-1.787	-2.011***	-1.666	-2.459
	(1.447)	(1.328)	(1.459)	(0.762)	(1.371)	(1.677)
Widow	-3.5	6.425	-3.279	1.457	-3.793	-3.281
	(13.679)	(7.918)	(13.571)	(6.83)	(13.47)	(15.219)
BA Degree	-2.095	-5.009	-2.607	1.591	-2.716	-4.719
	(1.779)	(3.269)	(1.869)	(2.332)	(1.796)	(4.733)
Some College	-0.859	-0.383	-1.222	4.76***	-1.377	-1.959
	(1.707)	(1.938)	(1.763)	(1.672)	(1.746)	(2.771)
High School Graduate	0.64	0.837	0.452	4.164***	0.008	-0.471
	(1.627)	(1.275)	(1.702)	(1.433)	(1.699)	(1.966)
Live Within a	-0.516	1.769	-0.479	-0.053	-0.469	-0.197
Metropolitan Area	(1.923)	(1.344)	(1.942)	(1.815)	(1.965)	(1.824)
N	2801	2552	2813	2552	2811	2539
R^2	0.68	0.62	0.68	0.625	0.68	0.4486

Sources: See Data Appendix
Variables are for the year 2000, unless otherwise specified
Robust standard errors (adjusted for within-state clustering) in parentheses.
* significant at 10%, ** significant at 5%, *** significant at 1%

Data Appendix

Description of Constructed and non-NLSY Variables

Posterior Probability of Unemployment. NLSY79 includes weekly data on employment status (working, unemployed, out of labor force, etc.) for each subject. What we would like to do is derive from this information an approximation of each respondent's subjective beliefs about the probability of experiencing involuntary job loss at the time of the 2000 survey (when final body weight is measured in our sample). In calculating this probability, we posit that it is fixed but unknown (to the worker) at the beginning of the worker's current career, and that each worker adjusts his beliefs in a Bayesian manner as time goes on. We calculate the posterior probability as follows:

Consider the fixed (but unknown) probability π of a worker becoming unemployed over a period of $n+1$ weeks. He knows at the outset that there are k possible values of π, denoted π_i for $i = 1, 2, \ldots, k$ and prior probabilities $P(\pi = \pi_i)$. After n weeks I observe that I have been unemployed for a total of $x \leq n$ weeks. The probability that I will be unemployed in week $n+1$ is then given by

$$\sum_{i=1}^{k} \pi_i P(\pi = \pi_i \mid x) \tag{6}$$

where

$$P(\pi = \pi_i \mid x) = \frac{P(x \mid \pi = \pi_i) P(\pi = \pi_i)}{\sum_{j=1}^{k} P(x \mid \pi = \pi_j) P(\pi = \pi_j)} \tag{7}$$

and (since for any given value π_i, x is the realization of a binomially distributed random variable)

$$P(x \mid \pi = \pi_i) = \frac{n!}{x!(n-x)!} (\pi_i)^x (1 - \pi_i)^{n-x} \tag{8}$$

To implement (6), we generated values for π_i (job-loss hazard) and $P(\pi = \pi_i)$ (prior probability of a given hazard level) from the sample of 5507 male NLSY79 respondents for whom comprehensive weekly employment data is available during our sample window. In particular, observations on the total number of weeks of unemployment experienced were sorted into 100 bins (i.e., of approximately 55 observations each); π_i was then calculated as the mean hazard (number of weeks unemployed divided by total number of weeks) for individuals in the *i*th bin, with prior probability $P(\pi = \pi_i)$ given by the number of observations in bin *i* divided by the total number of observations.

Annual Income: Rate of Change and Goodness of fit, 1988-2000. Annual family income is reported in NLSY79 for each survey year. These variables take these year/income pairs and apply simple least-squares regression calculations, with a separate regression for each individual for whom at least three annual income levels are reported. The "Rate of Change" is the slope coefficient (interpreted as the annual change in income per year), and "Goodness of Fit" is the R^2 of this regression. I.e.,

$$\text{slope} = \frac{n\sum_{i=1}^{n} ty - \sum_{i=1}^{n} t \sum_{i=1}^{n} y}{n\sum_{i=1}^{n} t^2 - \left(\sum_{i=1}^{n} t\right)^2} \tag{9}$$

and

$$R^2 = \frac{\left(n\sum_{i=1}^{n} ty - \sum_{i=1}^{n} t \sum_{i=1}^{n} y\right)^2}{\left(n\sum_{i=1}^{n} t^2 - \left(\sum_{i=1}^{n} t\right)^2\right)\left(n\sum_{i=1}^{n} y^2 - \left(\sum_{i=1}^{n} y\right)^2\right)} \tag{10}$$

where n is the number of years for which income observations are available, and y and t are income and the year in which observation i is reported, respectively. Of course, R^2 will take a maximum value of 1, with larger values indicating fewer (or smaller) deviations from a linear trend in income.

Health Insurance Policies. Seven state-level measures of health insurance-related regulation were obtained from the December 1999 *State Legislative Health Care and Insurance Issues* published by BlueCross BlueShield Association. *Plan Liability* indicates whether a state has laws in place that hold health plans and their employees liable for damages for harm to enrollees; *No. of Mandates* is a count of the number of specific plan mandates (benefits, providers, or persons covered) written into state law; *NAIC Rating Bands*, *Tight Rating Bands*, and *Community Rating* are various measures of the extent to which plans can use experience, health status, and/or duration of coverage in setting small group rates; *Any Market Reform* is a composite of these three variables, applied to the market for individual plans; and *Guaranteed Issue* states require health plans to offer coverage to all individuals regardless of their health status or claims experience.

Hourly Wage. This variable was constructed by dividing annual wage income by total hours respondent reported working in 2000. Both are NLSY79 variables.

Median Household Income. This variable represents the median household income in respondent's state of residence in 2000; this data comes from the U.S. Statistical Abstract.

Minimum Wage. Nominal minimum wages for all 50 states and the District of Columbia for 2000 are used. Data are in dollars. Data were obtained from

Neumark and Nizalova, NBER Working Paper #10656 2004, http://www.nber.org/papers/w10656.

Number of Drops in Real Family Income, 1988-2000. Family annual income in each survey year is reported in NLSY79. This variable is a count of the number of times family income (adjusted for inflation) was lower than the most recently reported previous income.

Self Reported Weight and Height Corrections. Self-reported weight and height were corrected for reporting bias using the method described in Cawley (2000). Matched data on reported and actual heights and weights from the NHANES III survey were used for this purpose. Separate OLS regressions were performed for each sex and race/ethnic group.

To estimate the actual weight in pounds of an individual, actual weight of the subset of NHANES III respondents between the ages of 26 and 45 was regressed on reported weight (in lbs.), reported weight squared, and the respondent's age in years. Estimated coefficients were then used to correct for the bias. Coefficients for reporting error in height were computed by regressing actual height on reported height (in inches) and reported height in inches squared.

Smoking/Cigarette Variables. We constructed a variable that represents whether an individual smokes at the time of the interview. This is used in the year 2000. The NLSY79 question is do you smoke now? With responses: daily, occasionally, and not at all. We formed daily and occasionally into one group and not at all into a separate group in order to form a single dummy variable.

Data on cigarette price and cigarette taxes for each state in the years covered are from *The Tax Burden on Tobacco*, by Orzechowski and Walker.

Welfare Benefits. Welfare benefits data for 2000 is obtained from the *Green Book*, published by the Congressional Committee on Ways and Means (http://www.gpoaccess.gov/wmprints/green/index.html). The data provided is the maximum payment in dollars a family of three would receive in each state.

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