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Abstract: We hypothesize that recent trends in U.S. and worldwide obesity are, in part, related to an increase in the marginal rate of time preference, where time preference refers to the rate at which people are willing to trade current benefit for future benefit. The higher the rate of time preference, the larger is the factor by which individuals discount the future health risks associated with current consumption. Data from the United States, as well as international evidence, suggests that a relationship between these two variables is plausible. We encourage researchers to explore the possible link between obesity and time preference, as important insights are likely to result.

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Obesity and the Rate of Time Preference: Is there a Connection?

That obesity worldwide has increased recently is well known (Popkin and Doak, 1998; Flegal et al. 1998; Mokdad et al. 1999; Philipson 2001). Obesity raises the risk of heart attack and diabetes and decreases both labor productivity and life expectancy (Colditz, 1992; Allison et al., 1999). The economic costs of obesity are substantial: in Germany, for example, the annual costs attributable to obesity are on the order of \$10 billion (Bergmann and Mensink, 1999). In the U.S., obesity is second only to tobacco consumption as a cause of death that could be prevented by behavioral changes (McGinnis and Foege 1993).

Biologically, the cause of weight gain is uncontroversial: all animals gain weight if they take in more calories than they expend. Humans gain approximately one pound of fat for every 3,500 kilocalories net intake. However, the hypothesized causes of recent increases in the prevalence of obesity are controversial and consequently policy recommendations to combat it are unclear.

Several economists have argued that technological change has led to increasing rates of obesity by simultaneously lowering the relative price of food and reducing the amount of physical activity required at work and in daily activity (Philipson, 2001; Philipson and Posner 1999; Lakdawalla and Philipson 2002; Cutler, Glaeser, Shapiro, 2003). While agreeing that technological change is an important cause of the rise in obesity, we suggest that a complementary factor bears further investigation. We hypothesize that an increase in the rate of time preference also contributes to the obesity epidemic. Time preference refers to the rate at which people are willing to trade current benefit for future benefit and is used in economics to explain savings and investment

behavior. Various social, cultural and psychological factors influence a person's time preference. One aspect of weight control requires one to forego current consumption in order to gain future potential health benefits, so the rate at which future benefits are discounted will bear directly on the individual's current food consumption decisions. As Offner (2001) notes: "for weights to rise, it was necessary for people to prefer the immediate gratifications of eating, to the delayed ones of normative appearance" (p. 84). Similarly, exercise requires the expenditure of time (with its associated opportunity costs) and effort today for the sake of potential future health benefits. Exercise may also require monetary investment (e.g. joining a health club), because jobs are much less physically demanding now than in the past. Taken together, a higher rate of time preference will, *ceteris paribus*, lead to less investment in exercise and greater caloric intake, resulting in weight gain and increased obesity.

The next two sections present our theory in detail. We then offer preliminary empirical evidence using aggregate data to suggest that our hypothesized relationship between the rate of time preference and obesity is plausible and merits further investigation. Indeed, we recognize that currently there is not sufficient evidence to rigorously test the role of time preference in the obesity epidemic. Our goal is to propose that changes in the rate of time preference may help explain recent trends in obesity. Our hope is that researchers will be encouraged to develop better measures of time preference and incorporate the role of time preference in comprehensive models of obesity.

Hypothesis: a relationship between impatience and obesity

The marginal rate of time preference, σ , is a measure of the rate at which a person is willing to trade current pleasure for future pleasure. The concept of time preference

reflects the degree of impatience of an individual, or collectively – of a society.

Economists refer to the satisfaction obtained from consumption as “utility,” and the

intertemporal discount rate, $\frac{1}{1+s}$, is used to calculate the present value of future utility.

Thus, the higher is time preference (σ), the lower is the value of future utility, and the greater is the impatience of an individual. If individuals value utility now as much as utility later, then their $\sigma = 0$, and their discount rate equals 1. In that case consumption in the future yields the same satisfaction as consumption today. In contrast, a person who does not value future utility at all ($\sigma = \infty$), has a discount rate of 0. Utility in the future is worth nothing to this person, only current utility matters. Thus, an increase in time preference (σ) implies that individuals value future utility less than they did previously.

The significance of the rate of time preference in health outcomes has been amply recognized, but its connection to obesity has largely remained unexplored. Grossman (1972) first used the concept of time preference to analyze health choices, basing his work primarily on the theory of investment in human capital (Becker 1964). According to Fuchs (1986, 1991), differences in the rate of time preference can help explain variations in a number of health-related choices, such as smoking, diet, and exercise. Ehrlich and Chuma (1990) predict that higher rates of time preference lead to lower demand for longevity and less investment in health. Bishai (2001) reports evidence that lower rates of time preference are associated with lower alcohol consumption among adolescents. Blaylock et al. (1999) assert that American dietary habits suffer despite extensive information on the relationship between health and nutrition, because Americans discount the future heavily. Levy (2002) presents a model of weight that incorporates the rate of

time preference and demonstrates theoretically that the utility maximizing equilibrium weight may exceed the medically optimal weight.

In contrast, Becker and Mulligan (1997) reverse the causation and argue that differences in health bring about differences in the rate of time preference. Healthy people expect to live longer and to be able to enjoy utility well into the future. Those with poor health do not expect to live as long, making the sacrifice of current utility in favor of future utility less attractive. Because obesity lowers life expectancy, the Becker-Mulligan model implies that its prevalence would raise the rate of time preference.

Has the marginal rate of time preference increased? The increase in legal gambling in the U.S. over the past three decades suggests a shift towards immediate gratification, and thus an increase in time preference (National Gambling Impact Study Commission, 1999). Blaylock et al. (1999) note that personal savings in America has fallen and that credit card debt has risen, which also suggest rising time preference. Parker (1999) documents the decline in personal savings since 1980, as well as the decline in private savings and the rise in personal consumption as a percent of GDP. He investigates the possible causes and concludes that the prime candidates are “factors that increase the effective discount rate (p. 32).”

An increase in the discount rate may be related to large government transfers to the elderly (social security, Medicare) and to low-income households. It could also result from technological advances, which have increased the speed of delivery of goods and services, and have thus raised our expectations for quick satisfaction. Advertising strategies and increased communication capabilities may also contribute by encouraging

impatience and immediate gratification, and convincing consumers that larger meal portions of food are a good economic value.¹

Theoretical considerations

In order to consider the role of time preference in a typical consumer's maximization of lifetime utility (U), assume that U is a function of the consumption of goods and services (C) and health status (H). The latter depends on initial health endowments, investments in health (I), and past levels of health (H_{t-1}). Health investments include monetary expenditures on health-enhancing goods and services, such as preventative care and exercise equipment, and foregone current utility associated with health enhancing choices, e.g., skipping high calorie desserts and watching less TV.

Consumers are assumed to choose a time path of consumption and health investment over their lifetime (from time 0 to time T) so as to maximize lifetime utility, given their marginal rate of time preference (σ):²

$$\text{Max } U = \int_0^T e^{-\sigma t} U\{C_t, H_t(H_{t-1}, I_{t-1})\} dt \quad (1)$$

subject to a lifetime budget constraint:

$$\text{Present value of Lifetime Income} = \int_0^T e^{-rt} (P_c C_t + P_I I_t) dt \quad (2)$$

where $0 \leq \sigma \leq 1$ and $e^{(-\sigma t)}$ represents the “rate of decay” of future utility, and r is the market interest rate, P_c is the price of consumption, and P_I is the price of health investment. Consumers are assumed to be heterogeneous, so that σ varies across individuals and does not necessarily equal the market interest rate (r), as it would if all individuals were identical.

Persons with higher rates of time preference assign lower weights to future consumption and health and thus allocate more of their income to current consumption. In each time period, the utility from consumption C is immediate, whereas the utility derived from health investment occurs in subsequent time periods. Thus, people tend to consume (C) at a higher rate and invest in health less, the higher their rate of time preference. As a population's rate of time preferences rises, so will expenditure on non-health related consumption, whereas expenditure on health investment decreases. Thus, our hypothesis is that one possible cause of rising rates of obesity is a rise in the marginal rate of time preference.³

If time preference is increasing, why then do we observe significant spending on exercise equipment and health club memberships? A major factor motivating people to make such purchases is that they are currently overweight. Their previous choices, influenced by their marginal rate of time preference, have led them to the predicted outcome of excess weight. Furthermore, such purchases may yield some immediate gratification ("I may be overweight, but now I'm a member of a health club!"). However, what matters to body weight is not just whether one buys exercise equipment or joins a health club, but whether one regularly uses such equipment. Health investment (I) is not just the monetary costs of exercise equipment and health club memberships; it also involves the opportunity cost of spending time exercising. People with high time preference will quickly give up on exercising, rarely using their home or health club equipment. Thus, our hypothesized relationship between obesity and time preference is consistent with the observed paradox of increased obesity over a period of brisk sales of exercise equipment, health club memberships, and other weight loss programs.

Preliminary Empirical Evidence

In spite of the considerable importance of the rate of time preference in the theory of intertemporal decision-making, the empirical evidence on the marginal rate of time preference is controversial (Gafni, 1995; Barsky et al. 1997). Two general empirical approaches have emerged: estimation of modeling equations (Euler-equations) using consumption and savings data (e.g., Lawrance, 1991; Samwick, 1998) and survey questionnaires that ask respondents to make hypothetical financial or health trade-offs (e.g., Fuchs, 1986, 1991; Johannesson and Johnansson, 1997). The first approach requires identifying restrictions, for example, perfect capital markets, and assumptions about functional form and interest rate levels. The survey approach is subject to the usual problems: sensitivity to the wording of questions and non-response. In addition, good estimates require that survey respondents can predict accurately how they would respond in a variety of hypothetical situations. Further complications for all approaches involve the difficulty of distinguishing time preference from the interest rate and risk preferences.

Given the difficulties associated with the estimation of the marginal rate of time preference, we are unable to do more at this time than to use some available proxies to examine the plausibility of the hypothesized relationship. Specifically, we use the saving rate and consumer debt as indicators of the rate of time preference. Both are related to the degree of consumers' impatience, or the relative preference for current as opposed to future consumption (utility). Lower savings rates and greater debt suggest a higher rate of time preference; people are willing to incur debt in order to finance current consumption at the expense of future consumption. Shortcoming of this approach is that these proxies

are influenced by factors other than the rate of time preference and that debt includes expenditure for the accumulation of human capital.

Following the medical literature, we consider obesity for adults as having a body mass index ($\frac{\text{weight}(\text{kg})}{\text{height}(\text{m})^2} = \text{BMI}$) ≥ 30 (National Center for Health Statistics, 2000).

Figure 1 uses this definition and the results from the five waves of National Health and Nutrition Examination Study (NHANES) surveys to compare trends in the prevalence of obesity and the personal savings rate in the U.S.⁴ The obesity statistics pertain to adults between the ages of 20 and 74. Because weight gain is likely to lag changes in time preference, Figure 1 shows current obesity prevalence and the previous period's savings rate. Between the early 1970s and 1980 the rates of obesity and the previous period's saving both rose, even if slightly, contrary to our hypothesis. However, beginning with the late 1970s the savings rate fell while the prevalence of obesity increased - at first marginally, but then by the 1990s very substantially. From the 1970s until the end of the century the obesity rate increased by some 112%, while the personal savings rate fell by 83%. Thus, the trends of the past few decades are consistent with our hypothesis.⁵

The trend in lagged private consumer debt, measured as the ratio of household debt to disposable income (Debt/DPI), is also consistent with our hypothesis (Figure 2). Consumer debt increased from the 1960's to the end of the century, as did obesity rates,⁶ with both variables accelerating simultaneously in the 1980s and 1990s.

Figures 1 and 2 about here

We next consider cross-sectional evidence on the relationship between rates of time preference, proxied by savings rates, and obesity at the international level. If obesity is positively related to the rate of time preference, as we hypothesize, then obesity would

be more prevalent in nations with lower savings rates. Figures 3 and 4 compare the prevalence of obesity by gender (Molarius et al., 2000) and net domestic savings as a percent of GDP for a number of developed countries over the period 1989-96.⁷ While the inverse relationship between the two variables is by no means perfect, it is, nonetheless, suggestive that countries with low savings rates, such as Finland, Spain, and the U.S., have some of the highest obesity rates. The U.S. has the lowest net domestic saving rate (4.6%) and one of the highest obesity rates (among both genders). Conversely, Switzerland and Belgium have the highest net domestic savings rates and their obesity rates are about half that of the U.S.

Figures 3 and 4 about here

Discussion

Insurance companies, employers, governments, and health maintenance organizations, as well as individuals, must bear the significant financial burdens associated with obesity. The obese face significant social, psychological and cultural biases as well. Because the financial and social costs of obesity are high an economic approach to its analysis is warranted. This paper hypothesizes that there may be a positive relationship between the rates of time preference and obesity. Individuals with high rates of time preference will consume more high-calorie foods and non-physically active leisure pursuits at the expense of lower levels of health and utility in the future.

Both U.S. time series data and international cross-sectional data indicate that our hypothesis linking obesity and time preference is plausible.⁸ Obviously, more research and better data are needed to rigorously test our model. At the moment we can not distinguish between parallel trends and causal relationships. Nor can we determine if

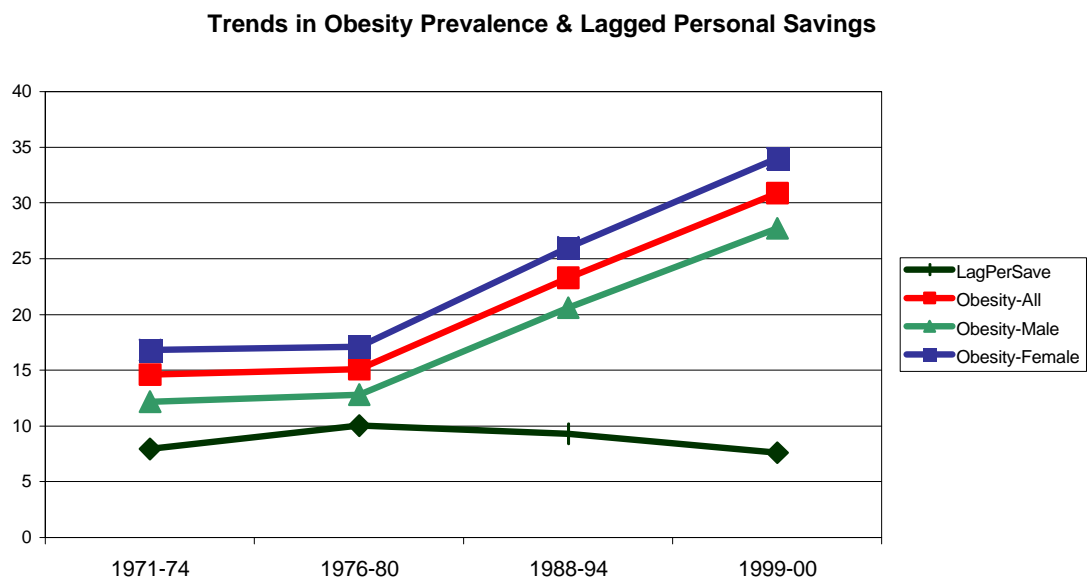
some unknown factor is simultaneously driving both the rates of time preference and obesity. Above all, we need better estimates of the marginal rate of time preference not only for the society as a whole, but also by groups within a society, *e.g.* by gender and income levels. Such estimates might help explain some perplexing patterns in obesity, such as the strong negative relationship between socio-economic status (SES) and obesity among women in developed societies, a relationship that does not hold for men (Fulwood et al. 1981, Sobal and Stunkard, 1989).

The international cross-sectional evidence is less compelling, but there are many additional cultural and economic factors, such as the rate of taxation and savings subsidies, that influence these variables across different institutional settings for which our analysis does not control. Also, many psychosocial and political influences render the international comparisons difficult. Nonetheless, the international evidence suggests that the rate of time preference may at least play a role in the recent global epidemic of obesity (Ulijaszek 2003). Development of internationally comparable estimates of the marginal rate of time preference would greatly improve examination of the possible relationship between this variable and a variety of health outcomes.

An increase in the rate of time preference is certainly not the only cause of obesity. We concur with the complementary theory that technological change has also had a significant impact on the propensity to become overweight.⁹ Nonetheless, the available evidence suggests that a rise in the marginal rate of time preference may also be a contributing factor to the problem of obesity and warrants both further research and concurrent consideration of policy measures. A policy implication that follows from these considerations is that measures that would tend to lower the marginal rate of time

preference of the population would help stem the obesity epidemic. Telling people to change their diets and exercise more may not suffice to alter their behavior in the long run, if their marginal rate of time preference does not decrease at the same time. Insofar as time preference is probably formed during childhood (Maital and Maital, 1977), it might well be useful to initially target programs to lower the time preference of parents and their young children.

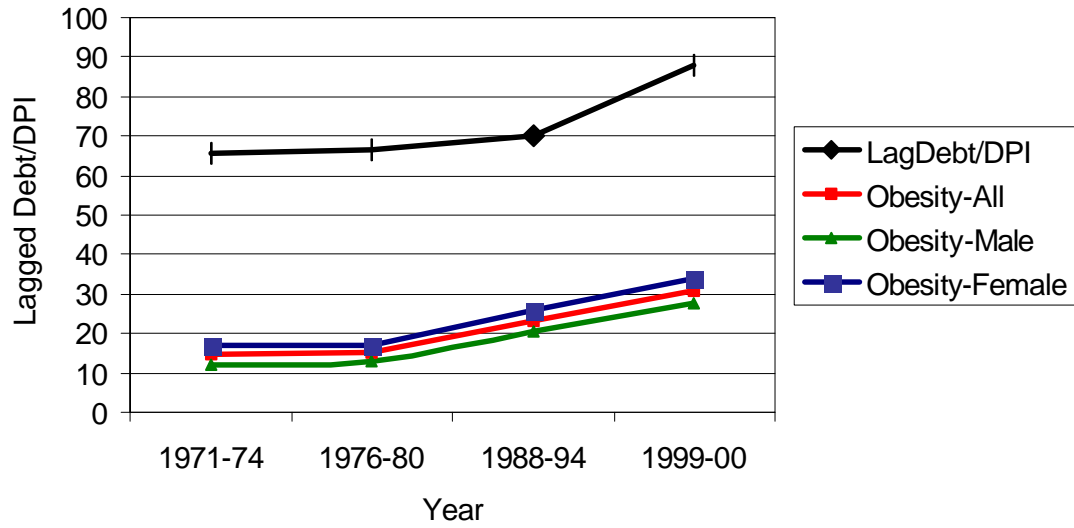
Figure 1



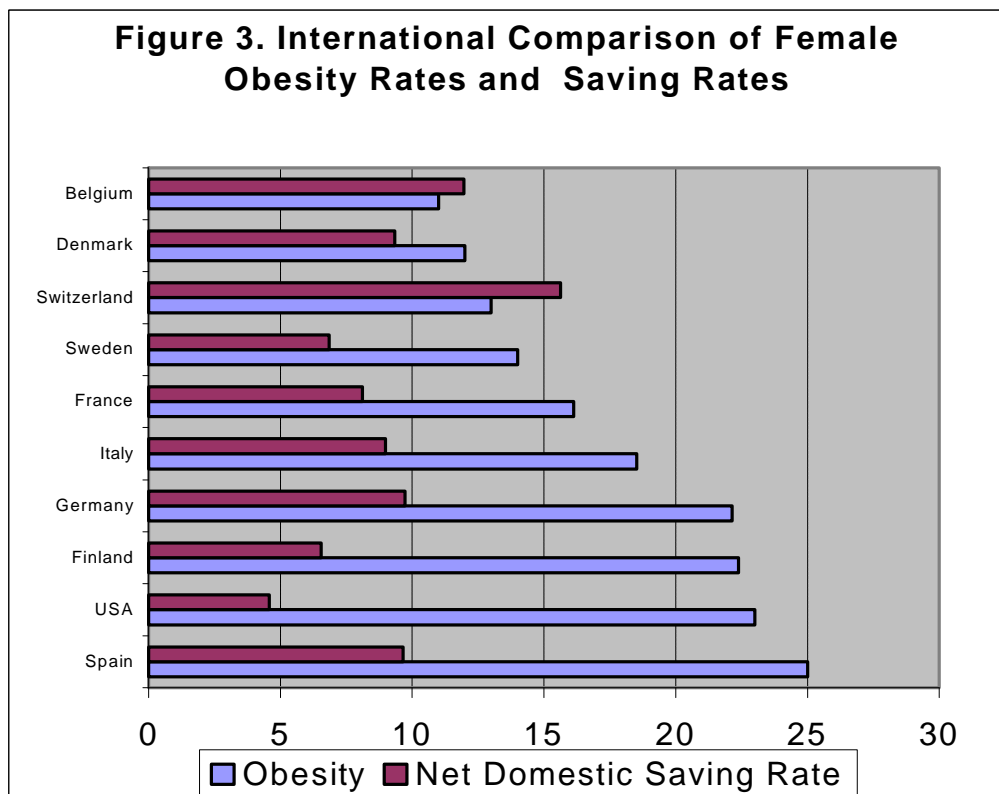
Sources: NHES I (1960-62); NHANES I (1971-74); NHANES II (1976-80); NHANES III (1988-94); NHANES 99/00(1999-00).

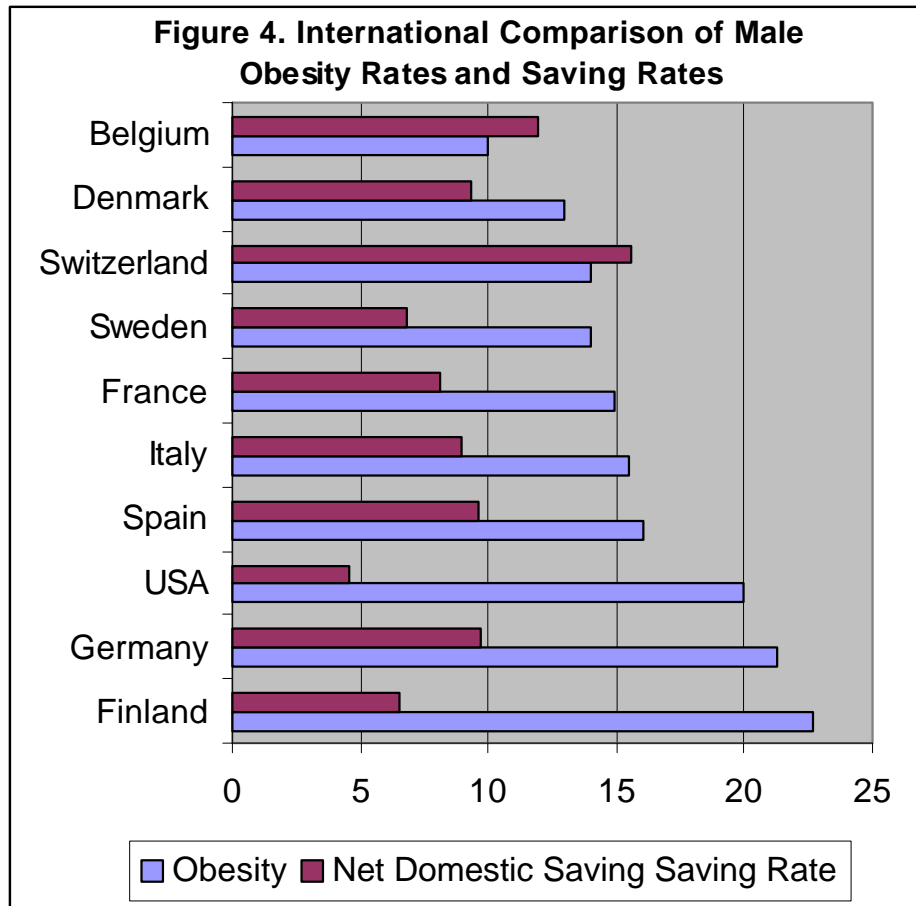
Figure 2

Trends in Obesity Prevalence & Lagged Debt-to-Income Ratio



Sources: NHES I (1960-62); NHANES I (1971-74); NHANES II (1976-80); NHANES III (1988-94); NHANES 99/00(1999-00).





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Endnotes

¹ Furthermore, advances in medical technology may have increased expectations for future cures and raised life expectancy to such a high age that the perceived marginal benefit of extending life further (by improved nutrition and exercise) is diminished.

² Bleichrodt and Gafni (1996) argue that the discount rate is not linear, and that it is higher for more distant years. Their focus is on analyzing health policy rather than the incidence of particular diseases.

³ The model could be adapted to account for the uncertainty associated with the health benefits that result from health investment by making H a stochastic function of I .

⁴ The Bureau of Economic Analysis reports the personal savings rate at www.stls.frb.org/fred/data/gdp/psavert.

⁵ Similar results are obtained when we use the ratio of real savings to disposable personal income reported by the Federal Reserve Bank of Philadelphia www.phil.frd.org/src/cf/backgrounddata4.htm.

⁶ Similar results are obtained when we use the ratio of real household debt to real disposable income (RealDebt/DPI) also reported by the Federal Reserve Bank of Philadelphia.

⁷ Data on net domestic savings as a percent of GDP are from the *World Development Tables*.

⁸ American insurance companies are increasingly using credit ratings to set premiums for home and auto insurance. Their data suggest that people with poor credit histories are more likely to have auto accidents and to file home insurance claims. This is consistent

with our theory that less forward-looking individuals will invest less in caring for themselves (Crenshaw 2002).

⁹ Competition among restaurants could also contribute to obesity if competition within a price category is not only along the quality, but also along the quantity dimension.

Markets might clear by restaurants engaging in a Bertrand-type competition in which the size of a meal is one of the control variables.