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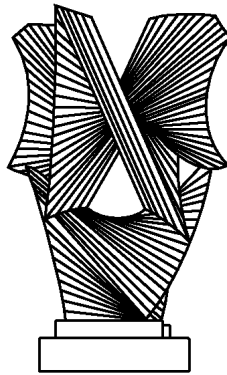
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The Long-Run Growth in Obesity as a Function of Technological Change

Tomas J. Philipson and Richard A. Posner***

Section 1: Introduction

Obesity is typically treated as a problem of public health or personal attractiveness. It is those things but it is even more an economic phenomenon. More than many physical conditions, obesity is avoidable by behavioral changes, which economists expect to be undertaken if the benefits exceed the costs. Investigating whether the economic benefits and costs of obesity can fruitfully be used to explain its variations across time and populations is the principal task of this paper.

In ordinary language, “obesity” is a pejorative term, as the related term “overweight” makes even clearer. In a rational-choice model, there is no such thing as being “overweight.” Weight is the result of personal choices along such dimensions as occupation, leisure-time activity or inactivity, residence, and, of course, food intake. Therefore, being either fat or thin may be as desirable as adhering to the norms of weight set by doctors and the public health community. At least since the 1960s (see Ippolito and Mathios (1995)), it has been known by the medical profession and widely disseminated to the public that obesity impairs health and longevity. It is currently estimated that mortality due to non-optimal levels of exercise and food-intake is second only to tobacco consumption in the number of deaths that could be prevented by behavioral change (McGinnis and Foege (1993)). Yet the percentage of obese people, commonly if rather arbitrarily defined as those who are more than 20 percent above their medically determined “ideal” weight, has been

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growing worldwide.¹ In one recent decade the percentage of Americans who are more than twenty percent above their “ideal” weight increased from about 25 percent to about 33 percent.² It has been argued that almost 60 percent of Americans do not exercise enough from the standpoint of controlling their weight (NIH (1995)). The increase in obesity has given rise to demands for public intervention, mainly in the form of education programs, to reduce obesity through diet and exercise.

We argue that there are important economic reasons for this long-run growth in obesity. Technological change has both lowered the cost of intake of calories and raised the cost of expending calories, hence contributing in two ways to the rise in obesity. The technologically induced rise in obesity offers many predictions, such as a natural interpretation of such puzzling phenomena as that obesity has grown even though there has been little or no increase in calorie consumption, and indeed a rise in exercising and dieting.

The price of calories has fallen because food prices have declined and income has grown and, consequently, a rise in weight would be a natural consequence, but it would be due solely to a rise in calorie consumption. An equally important change has been the amount of physical exertion required when supplying labor. In an agricultural or (to a somewhat lesser extent) an industrial society, work is strenuous; in effect, the worker is *paid* to exercise; what is more, in such a society, in which public welfare is ungenerous, the cost of not exercising through work could be dire—it could include starvation. Technological change has freed up time from producing food, enabling a reallocation of time to producing other goods and eventually to producing services. In a postindustrial and redistributive society, such as that of the United States today, most work entails little exercise and not working does not reduce weight; hence, people must *pay* for undertaking, rather than be paid to undertake, physical activity. This payment is mostly in terms of foregone leisure, so that

¹ The most comprehensive estimates of worldwide obesity is through the so-called MONICA study (see *Obesity: Preventing and Managing The Global Epidemic*, World Health Organization, Geneva, 1997, p. 19).

² VanItallie (1996), p. 891 (tab. 2) documents an age-adjusted increase in the prevalence of overweight among persons 20 to 74 years of age from 25.4 percent to 33.3 percent between 1976–1980 and 1988–1991. See also Kuczmarski et al. 1994.

leisure weight control must substitute for job weight control. The jogging and gym revolution and the limiting of calorie consumption as a result in part of deliberate dieting can be interpreted as substitutions brought about by technological changes in work. Despite these forces operating to reduce obesity, overall obesity may rise as a result of a growth in the sedentary nature of work. Indeed, the technology-of-work explanation of increased obesity is almost inevitable; since calorie consumption has fallen, physical activity must have fallen for obesity to have increased.

But if, as we believe, income increases the demand for thinness, this will imply that in technologically advanced countries, there will be a negative relationship between income and weight while in less technologically advanced countries the relationship will be positive. It also implies that technologically induced obesity growth will be *self-limiting* when it makes workers sufficiently richer. Increases in per capita income, while on the one hand associated with the shift from heavy to light work, both being consequences largely of technological progress, on the other hand increase the demand for thinness.

We conclude by considering the role of the expanding public interventions to reduce obesity.³ There have been dramatic warnings about an existing international obesity “epidemic,” but a rational-choice perspective calls into question the case for public interventions designed to reduce obesity. If health is not everything in life, rational people will eat more and exercise less than medical science advises them because they prefer such behavior to better health and a longer life. In particular, people may prefer their high paying sedentary jobs to more physically demanding ones with less pay. Preferences and technology determine obesity and will probably be little affected by public education campaigns about ways to limit weight gains.

The distinction is between an individual’s being overweight in a medical sense, which from a rational-choice perspective does not call for public intervention, and the population’s being overweight in a

³ For a comprehensive call for public international intervention, see *Obesity: Preventing and Managing The Global Epidemic*, World Health Organization, Geneva, 1997. For the United States, see e.g., the initiative *Healthy People 2000* (www.health.gov/healthypeople), or The President’s Council on Physical Fitness, the agency in charge for carrying out the objectives.

social Pareto-inferior way, implying that people would be willing to pay others to reduce weight. Interventions in the food market may induce overweight in the social Pareto sense. The food-stamp program, for example, may raise the incidence of obesity among lower-income persons. Antismoking measures may likewise increase obesity and by doing so reduce the health benefits of these measures, because smoking is a substitute method of weight control, and so the heavy taxes and regulations aimed at smokers may induce people to be overweight in a Pareto sense. We doubt that obesity generates negative externalities large enough to justify government intervention to reduce its prevalence⁴, but in any event such measures should be discussed in light of an understanding of how private behavior has induced the growth in obesity.

There has been little economic analysis of the forces contributing to obesity, although the question is related to, but distinct from, other human capital issues in health.⁵ The neglect by economists is surprising because more Americans are obese than smoke, use illegal drugs, or suffer from obesity-unrelated ailments; because obesity is a substantial risk factor in most highly prevalent serious diseases, including heart disease, cancer, and diabetes and therefore affects major public programs such as Medicare and Social Security; because obesity affects wages; and because Americans spend in the aggregate many billions of dollars each year trying to lose weight through dieting or exercise. Attempting to understand what has contributed to the growth in obesity, and the impact this has had on the demand and supply for health care, therefore seems a natural topic for health economics. The main analytical difference introduced by weight as a health stock is that of a nonmonotonicity. People have an ideal weight that they prefer not to be above or below, and this nonmonotonic effect of weight on utility drives many of our results, such as the change in sign induced by economic development on the income effect on weight.

⁴ However, see Keeler et al (1989) estimate the external costs imposed by those of sedentary life-styles through lack of price-discrimination in insurance coverage.

⁵ See, e.g., Grossman (1972), Arthur (1982), Ehrlich and Chuma (1992), Rosen (1988, 1994), Philipson and Becker (1997), and Cawley (1999).

Section 2: The Demand for Weight

The Determination of Weight without Labor Supply

We first consider the individual's choice of weight when income is exogenous. This case is simpler and serves as a useful illustration of the main effects that operate in the more general case when income is earned through participating in the labor market. Consider an individual with income I for whom the net consumption of calories less spending on physical activity is denoted F for "food." Weight is affected by the net intake of calories according to the increasing function $W(F)$; that is, a higher net intake of calories raises weight. Utility $U(W(F), C, F)$ is defined over weight, alternative consumption (denoted C), and net intake of calories. An important property of the utility function is its monotonicity. Specifically, it has an inverted U-shape; there is an ideal weight W_0 which the individual does not prefer to be above or below. We assume that this ideal weight does not depend on other goods, so that the cross-partials are zero, $U_{WF} = U_{WC} = 0$. In other words, W_0 is the weight that would be chosen if achieving one's preferred weight was costless. We also assume diminishing marginal utility from raising net intake of calories, $U_{FF} \leq 0$, and that changing one's weight affects one's utility more the further away from one's ideal weight one is; that is, the inverted U-shaped function over weight is concave ($U_{WW} \leq 0$).

A person's ideal weight W_0 may or may not correspond to the weight that maximizes health or longevity, although it is likely to be influenced by concern with these factors. Consequently, being overweight is not an objective matter but a subjective one; thin girls may prefer to lose weight and fat middle-aged men may think they are at the weight they should be. Moreover, even people who, *ceteris paribus*, preferred to be at the weight that would minimize the adverse consequences of being overweight that are stressed by the public health community, might choose not to be. We'll call the weight that the public health community thinks ideal W_m . Neither W_0 nor W_m is an optimum in the economic sense. That optimum depends on costs as well as preference. It is found by solving

$$\text{Max } U(W(F), C, F) \quad \text{s. t. } C + pF \leq I$$

where p is the price of net calories. Substituting in the budget constraint, the necessary condition for an interior choice of calories balances the desire for consuming calories with its weight effects and the foregone consumption of alternative goods. Thus,

$$U_W W_F + U_F = p U_C.$$

This tradeoff will lead to a desired level of calorie intake $F(I, p)$ and hence to weight as a function of income and price:

$$W(I, p) = W(F(I, p)).$$

Price and income have opposing effects on weight. Price raises the cost of calories, while income lowers it by reducing the value of the foregone consumption of other goods:

$$dW/dp \leq 0 \quad \text{and} \quad dW/dI \geq 0.$$

A more interesting feature of the model is that there are limits to the effect of lower prices or higher income on weight. For very high incomes or very low prices, weight will be inelastic to them. To see this, notice that the marginal benefit (LHS) of the first-order condition above will be declining and become negative at the caloric intake level, denoted F_m , that would maximize the utility from eating if food were free. The corresponding weight $W(F_m)$ at that level will be larger than the ideal weight. Beyond this caloric level, there is a marginal cost of consuming more calories even if they are free because the gain in weight dominates the joy of eating. A person would never consume beyond F_m regardless of the price. Consequently, at very low prices of food further reductions in price are unlikely to have any effect on weight. The inframarginal effect of reducing prices or raising income is limited

$$\lim_{p \rightarrow 0} W(I, p) = \lim_{I \rightarrow \infty} W(I, p) = W_m$$

The conditions for being rationally over- or underweight are thus rather weak, in the sense that for many prices and incomes $W(I,p)$ differs from the ideal weight W_0 . Consider the quasi-linear utility function of the form

$$U(W(F), C, F) = (-a/2)[W(F) - W_0]^2 + C + bF$$

when the relationship between calories and weight is proportional, i.e., $W(F) = dF$. This can be shown to imply the optimal weight

$$W(I,p) = W_0 + (b-p)/ad.$$

The individual is below his ideal weight if the price of calories (p) is high relative to his preference for food (b). The amount over- or underweight will depend on how much he cares about his weight (a) and the impact of calorie consumption on weight (d). Clearly the optimal weight is often different from the ideal weight. Generally, the ideal weight is optimal when $U_W = 0$ and $U_F = pU_C$. This rarely holds, which helps explain the number of under- and overweight individuals and the divergence between subjective and objective obesity. The U.S. National Center for Health Statistics reports that about 44% of women and 25% of men who are classified as underweight by the medical profession perceive themselves as overweight (Statistical Abstract of the U.S. (1998), tab 243).

There is no income effect on weight in the model developed thus far because the willingness to trade off weight and food does not depend on income in the model. If, however, income or consumption is complementary to weight concerns, as where there are income-related motives to invest in health (e.g., Grossman (1972)), then wealthier individuals will gain more from weight gains when underweight and weight loss when overweight than poorer individuals do. This relation can be represented by a steeper inverted U-shaped utility over weight for wealthier individuals. In a modified version of the utility function discussed above,

$$U(W(F), C, F) = (-aC/2)[W(F) - W_0]^2 + C + bF,$$

the marginal value of weight control is changed from being independent of income, a , to being positively dependent on income through consumption, C .⁶ This implies that the income effect on weight interacts positively with price, as in

$$d/dp[dW/dI] \geq 0.$$

Hence, the effect of income on weight would fall with development because more technologically advanced countries would have a higher ratio of income to costs of producing food: I/p . Such an interaction between technological advancement and the income-weight relationship is illustrated in Figure 1.

In words, when food prices are low, other things constant, people prefer to consume calories, but concern with being overweight limits caloric intake. Wealthier individuals care more about their weight, for health or other reasons, so they limit more how much they are overweight. When food prices are high, many people are underweight because they cannot afford sufficient caloric intake, but wealthier individuals forgo other consumption in order to gain weight. Consequently, technologically backward countries, in which the share of income spent on food is large because food is expensive to produce, will exhibit a positive relation between income and weight because richer individuals care more about their health, while for the same reason technologically advanced countries, in which income is high relative to the price of food, will exhibit a negative relationship between income and weight. Thus in poor or early societies the more obese are relatively wealthier, but in wealthy, more modern societies the more obese are relatively poorer. Without other effects operating at the same time, such as the effect of technological change on the sedentary nature of work discussed in the next section, income growth will tend to make obesity growth self-limiting.

⁶ The necessary first-order condition would be $ap/2[W(F) - W_0]^2 - a[I - pF]/2[W(F) - W_0]d=p-b$ in which the marginal cost of non-ideal weight rises with income.

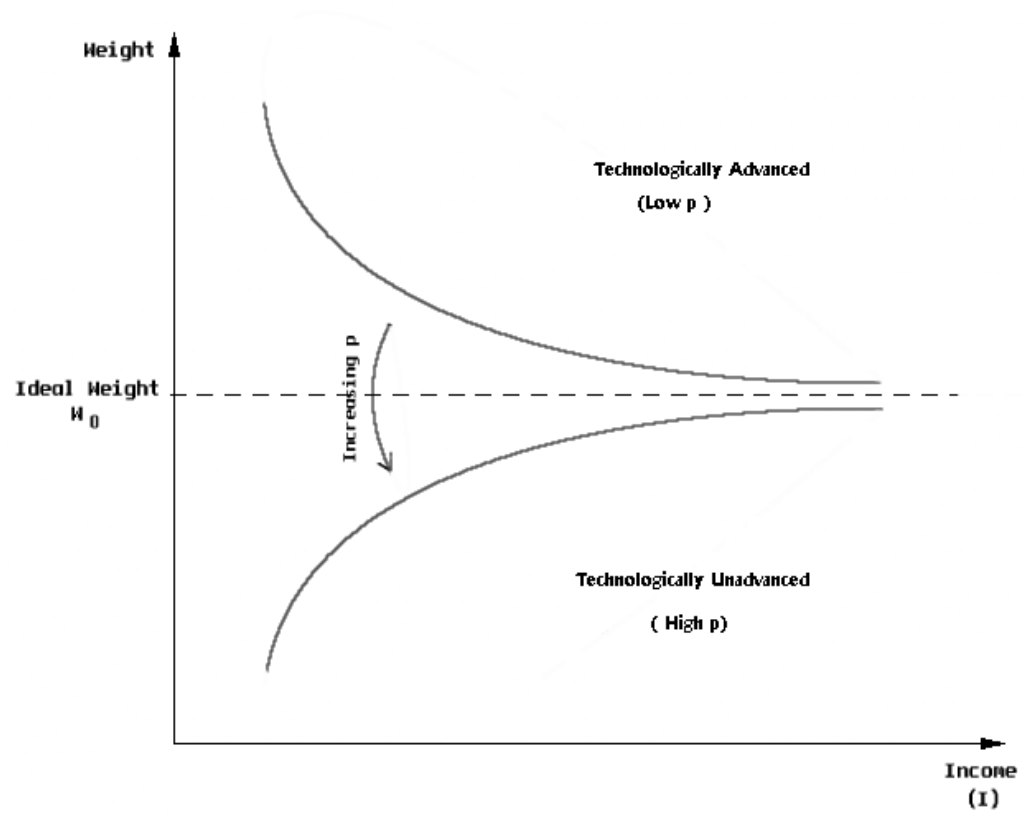


Figure: The positive interaction of calorie price on the weight-income relationship; $\frac{d}{dp} \left[\frac{dH}{dI} \right] \geq 0$.

The Allocation of Time, Technological Change, and Obesity

This section considers the effects of the allocation of time, and in particular labor supply, on weight. The hours or weeks one works affect weight in at least two respects. The first is through increasing earned income, which we have shown has an important effect on weight. The second is through affecting the amount of calories expended on the job. In physically demanding jobs, workers *get paid to exercise*. As technological change has lowered the calories spent per hour worked, it has reduced the financial incentives to control weight and so has raised obesity, but this has been accompanied by a rise in off-the-job calorie spending, e.g., the recent rise in jogging and gyms,⁷ a substitution brought about by change in the nature of work.

To incorporate the allocation of time in the analysis, we generalize the budget constraint to include earned income in addition to unearned income

$$C+pF+qE \leq wH+I$$

where w is the hourly wage, q is the resource cost of exercising, and H is hours worked. The time constraint states that time allocated to exercise (off-the-job calorie spending), together with leisure and work, cannot exceed available time

$$H+L+E \leq T.$$

The time spent in off the job exercise, E , thus consists of active measures of weight reduction. These measures, which need not be intended to control weight, include smoking, taking diet pills (as distinct from eating less), and non-working time devoted to exercise; hence “leisure” in our analysis is limited to physically inert as distinct from physically active leisure-time activities.

Weight is now affected by food, labor supply, and off-the-job exercise $W(F,H,E)$. The marginal effect of work on weight, W_H ,

⁷ On the efficacy of leisure-time physical activity as a method of weight control, see, e.g., Haapanen et al. (1997); Williamson et al. (1993).

can be negative, if work involves exercise, or positive, if work is sedentary. Technological change has raised the marginal impact of labor supply on weight; the calories spent per hours working has fallen as economies have gone from being agricultural to being based on manufacturing and now to being based on services. The individual chooses hours of work and of exercise, as well as of food consumption, to maximize

$$U(W(F,H,E), I+wH-pF-qE, F, T-H-E).$$

The necessary first-order conditions for an interior maximum are

$$(1) U_W W_H + U_C w = U_L \quad (\text{Labor Supply})$$

$$(2) U_W W_E + U_E = U_C q + U_L \quad (\text{Exercise})$$

$$(3) U_W W_F + U_F = U_C p \quad (\text{Calories}).$$

Equation (2) implies, for anyone who does exercise, that since (inert) leisure presumably is valued (so that $U_L > 0$) and exercise reduces weight ($W_E < 0$), weight must, at the margin, have a negative effect on utility ($U_W > 0$); otherwise no one would exercise. By the same token, for someone who does not exercise, the marginal effect of weight on utility must be positive, since lack of exercise will tend to lead to a weight gain. This in turn implies that in equation (1) the utility that an exercising person obtains from working an extra hour in a sedentary job is less (other things equal) than for a non-exercising person, because the extra hour of sedentary work versus exercise results in higher weight, while this relation between the benefits/costs of extra work is reversed for nonsedentary work (the exerciser benefits more). And in equation (3), the exerciser derives more, and the nonexerciser less, utility from consumption of other goods.

The full effect of any parameter x on weight depends on how it directly affects weight-holding inputs constant together with how it

affects the inputs into producing weight. Differentiating weight with respect to x yields:

$$dW/dx = W_x + W_F(dF/dx) + W_H(dH/dx) + W_E(dE/dx).$$

Consider the effect of changes in the sedentary nature of jobs, that is, that people historically had to exercise to get paid but today do not. The model may seem to imply that utility is maximized at a higher weight if $W_H=0$ than if $W_H>0$. Hence the secular shift in work from manufacturing and mining to services implies, because most (though not all) services involve light work, that average weight will be higher in modern, developed nations because there is less on-the-job exercise. This implication continues to hold if we consider the impact of wages on weight. The technological change that lowers physical activity on the job also raises productivity and hence wages, which in turn affect weight by affecting hours worked, exercise, and food consumption. The effects are unambiguous for exercise and food: an increase in wages raises the opportunity cost of time devoted to exercise and so lowers the amount of exercise and therefore raises weight, and an increase in earned income also increases the amount of food consumed. The effect of wages on weight through the effect on the number of hours worked is ambiguous because the work is sedentary, the effect will be to increase weight, and if it is nonsedentary to decrease it. But given the shift from manufacturing to services, the analysis of the effect of wages on weight reinforces the conclusion from the shift itself.

To illustrate these arguments more precisely, consider the simple form of the weight function

$$W(F,H,E) = W(F - (1/h)H - E)$$

where a rise in the parameter h represents fewer calories expended per hour worked. Assume that wages are related to this technology through $w(h)$, which is an increasing function: less physically

demanding work is associated with wage gains⁸. The total weight effect of technological change is given by

$$dW/dh = W_h + W_F(dF/dh) + W_H(dH/dh) + W_E(dE/dh).$$

The effects of technology on the inputs into weight are a direct effect through h and an indirect effect through the rise in the wage: $dK/dh = K_h + K_w w_h$ for $K = F, H, E$. The first direct effect of technological change on weight is positive, holding the inputs constant, simply because fewer calories are expended at work: $W_h \geq 0$. This effect may dominate the effect due to the input changes. More important, these inputs may be offsetting the direct effect on weight, so that weight gains may occur although food intake is falling and off the job exercise is rising. In other words, $dW/dh \geq 0$ may hold together with $dF/dh \leq 0$ and $dE/dh \geq 0$. Tugging the other way is the assumed positive income elasticity of the demand for thinness in wealthy countries, itself a consequence in part of rising wages. The observed jogging and gym revolution and the fall in calorie consumption, including dieting, is a substitution brought about by technological change at work and may offset a rise in obesity due to work-related technological change.

People may respond to the lower amount of calories spent at work in different ways. It might seem that since reducing the amount of food consumed reduces money costs, while increasing the amount of exercise increases time costs, poor people concerned about their weight would prefer to diet, as that would free up resources for alternative consumption, while rich people concerned about their weight would reallocate their non-work time from leisure to exercise. The secular decline in the monetary cost of food, however, might be expected to lead poor people to substitute food for other forms of consumption, an effect amplified by the food-stamp program, and hence to become fatter. This substitution would be less likely for rich people because the demand for food by rich people

⁸ Such earnings effects of sedentary technological change may change estimates of the external costs imposed by the obesity on the thin through public insurance (see e.g. Keeler et al (1989)).

is less price elastic (see Popkin (1999), p. 144), the health risk and other “disbenefits” of eating being a larger component of the full cost of food for rich than poor people.

Consistent with this suggestion, there is considerable evidence that obesity today falls with income and education in rich countries (see, e.g., Jeffery et al. 1991). An interesting cross-country comparison is between the United States and Europe. Food is cheaper in the United States than in Europe; Europe is less “suburbanized” than the United States; and this, plus the much higher price of gasoline in Europe than in the United States (due to steep difference in gasoline-tax rates), causes Europeans to be less sedentary. On all three counts we expect Americans to be fatter, on average, than Europeans; and it appears that they are, although comparison is difficult because of different methods of measuring obesity (on both points, see Seidell (1995)). Another difference is that Americans watch television much more than Europeans, in part because American television offers much more variety than European. About half the leisure time of the average American is spent watching television (Robinson and Godbey (1997))—a completely sedentary activity.⁹ The higher the quality of television is, the higher is the cost of exercise and hence the lower the demand for thinness, other things being equal. Television is a peculiar product because the marginal pecuniary cost of consumption is zero (except for pay television), and so small increases in perceived quality may lead to significant increases in amount demanded.

Asymmetric Information and Obesity as a Signal

It is often argued that income was positively related to weight historically because being obese indicated a high status when not everyone could afford to eat. This is essentially an argument of weight as a signal under asymmetric information about wealth, and provides an alternative to our hypothesis, which emphasizes food prices and the effect of changes in labor technology. In the nineteenth century, thinness was a signal of malnutrition and tuberculosis, and fatness a signal of prosperity; stout men and women were therefore considered handsome and stout women

⁹ Except for people who use exercise machines at home or in gyms. Such machines, especially treadmills, can be used while watching television.

beautiful and sexy.¹⁰ Of course, it may be doubted how many people actually overate in order to signal prosperity, since alternative, less costly signals were available. With the virtual eradication of malnutrition and tuberculosis in the wealthy countries, and with expenditures on food a steadily falling percentage of household expenditures, obesity ceased to have value in signaling valued traits; instead it became a negative signal (Cassell (1995)). Today, thinness may be valued as a signal of trustworthiness, both because it indicates a degree of self-control or self-discipline (Brownell (1991), p. 4) and because it indicates an orientation to the long term that is correlated with the possession of character traits important in employees who are not continuously monitored. One aspect that limits the signaling explanation of obesity, however, is that weight is an imperfect signal. People differ in their genetic ability to control their weight (Bouchard (1991); Brownell (1991), p. 8), and so one's amount of willpower or self-discipline cannot simply be "read off" from one's thinness.

Weight as a signal would imply as with other signaling activities that there may be overinvestment in thinness from a social standpoint, which in turn would cast doubt on the value of public programs designed to combat obesity. The overinvestment thesis is supported by the fact that women compete to be even thinner than men consider optimally attractive (see, e.g., Czajka-Narina, Dorice, and Parham 1990).

Section 3: The Supply of Obesity

Obesity is a supply as well as a demand phenomenon. Calories influence obesity and are supplied in food; caloric reduction is supplied in the form of dietary advice, discrimination and ridicule, and exercise advice, facilities, and equipment. We have already stressed the important components of food suppliers by reducing prices through agricultural technological change. We argued that this technological change on the supply side had two positive effects

¹⁰ To see this clearly, imagine that people spend 100 percent of their income on food, which is approximately true historically. Then poor people will eat less than rich and so be thinner, and weight will be a good signal of income.

on obesity; the first to lower food prices, the second to lower the calories spent per hour worked.¹¹

A curious supply feature of calories that affects supply behavior, and one with important implications for producers and public policy, is that the intensive and the extensive margins of consumption are substitutes, because “excessive” caloric intake impairs longevity, rather than complements. Compare the case of pharmaceuticals, where consumption increases longevity and, in turn consumption. A tax on calories (parallel to the tax proposed in the first Clinton administration on British Thermal Units (BTUs)) would reduce consumption of high-calorie foods in the short run, but there would be an offset in the long run because people would be living longer. In contrast, a tax on pharmaceuticals would unambiguously reduce consumption because it would have a depressive effect on both margins.

There are a number of possible supply side explanations for the puzzling increase in the obesity of Americans in the 1980s. First, because of the increased opportunity costs of household production, the 1980s witnessed a shift in food consumption from homemade food to restaurant (including fast food) and carryout food (Haines et al. (1992)). Homemakers and restaurants have different incentives with regard to caloric supply. The homemaker presumably internalizes the health costs of a calorically rich diet; the restaurateur does not. Hence the latter will have a greater incentive to supply foods that create addictive cravings (such as sweets). (For empirical evidence, see Haines et al. (1992).) Competition could in principle correct this externality; some restaurant owners would advertise and sell healthful meals. The problem is that since the benefits of a healthful diet are long term, consumers will tend to mistrust such advertising; poorer consumers, who have high discount rates and high costs of information, may be completely beyond the influence of such advertising. Consumers will be more trusting of advertising for diets and exercise machines, since short-term weight losses are feasible and will be observed, enabling the consumer to verify the advertiser’s claims.

¹¹ See Geoffard and Philipson (1998) for a more general discussion of this link between the two margins of consumption.

Another possibly relevant development in the 1980s is the decline in (male) cigarette smoking (Grunberg and Klein (1998), p. 174; WHO (1999)), a result in part of governmental measures to discourage smoking. Because of its weight-controlling effect, smoking is a substitute for exercise, and for many people a lower-cost substitute since it is less time- and effort-intensive, and often less costly (when exercise requires buying expensive equipment or joining a health club). If the cost of smoking rises either because of price increases (for example as a result of increases in the excise tax on cigarettes) or because of nonmonetary factors such as restrictions on where one may smoke or increased fear of lung cancer, then weight will rise to the extent that exercise is not a perfect substitute, although the availability of exercise as a substitute will limit the effect of a higher real cost of smoking on weight.

Still another factor is the improvement in the supply of medical technology. The principal health risk created by obesity is heart disease, because of the effect of obesity on serum cholesterol levels, blood pressure, sedentariness, and diabetes (itself a potent risk factor for heart disease). Technological improvements in the treatment of heart disease by drugs, surgery, and intensive-care units reduce the cost of obesity, in just the same way that improved treatments for sexually transmitted disease reduce the cost of unsafe sex. If the risk falls, this causes the price to fall, resulting in a higher demand. Since women are at less risk from heart disease than men, we can expect them to use greater inputs of smoking relative to exercise than men in attempting to control weight.

The first two hypotheses (shift to restaurant eating, and decline in smoking) are not well supported. The first implies an increase in average caloric intake, but it has decreased (e.g., Heini and Weinsier (1997)); and the effect of smoking on weight is small may be small while studies show that increased body mass immediately follows smoking cessation (see O'Hara et al. (1998), Green and Harari (1995), Flegal et al (1995), and Gerace et al. (1991)), few studies have followed former smokers after five years of cessation, so it is unclear whether the weight gain is permanent (Mizoue et al. (1998)). The decline in caloric intake, when coupled with the increase in weight suggests that physical activity decreased, which is plausible in light of the spread of labor-saving devices in homes and workplaces (see also Bouchard (1991)), and it has been argued that

the benefits of exercise are often exaggerated because exercise substitutes for other forms of calorie-burning physical activity¹² (Heini and Weinsier (1997)).

To summarize, improved medical intervention may have reduced the demand for thinness at the same time that increased costs of exercise (whether due to continued substitute of light for strenuous work, more television channels, or more household labor-saving devices) were increasing the supply price of thinness.

It is important to note, moreover, that there is nothing paradoxical in a reduction in caloric intake being associated with a decline in physical activity. It does not imply that people are inconsistent, that they want to lose weight so they eat less but then gain it back by exercising less. Food consumption and exercise are complements with respect to desired weight, since a reduction in food consumption reduces the marginal value of exercise, and vice versa. It is therefore easy to see that if at the same time that food consumption is falling (for exogenous reasons) the cost of exercise is increasing, the decline in food consumption may be negatively correlated with weight.

Section 4: Public Intervention to Limit Obesity

We conclude by considering the role of the expanding public interventions designed to limit or reduce the growth in obesity. The public health community has again blown the whistle on another forthcoming “crisis”—an international obesity “epidemic.” Adoption of a rational-choice perspective casts doubt on the case for public interventions designed to reduce obesity. One distinction here is between an individual’s being overweight in a medical sense, that is W being different from the ideal weight specified by other people, namely public health specialists—a discrepancy that does call for public intervention, and a population that is overweight with respect to its own ideal weight W_0 . But the case for public regulation does not concern deviations from either of these ideals, but rather concerns deviations from the Pareto optimum weight, deviations people are willing to pay others to reduce or eliminate.

¹² For example, a person may do less walking in order to make time for going to the gym.

Does obesity create negative externalities that might warrant public intervention, whether in the form of a calorie tax, subsidies for exercise, a tax on exercise substitutes such as driving, or public education subsidies? Although most people would derive benefits from increased “beauty” of strangers encountered in the streets and other public places and beauty in our society is negatively related to obesity, the pecuniary and nonpecuniary private benefits of beauty are so great that the elasticity of weight to tax or subsidy policies would probably be small. Moreover, personal beauty is a positional good: one is beautiful in comparison with other people who are less good looking. An increase in the number of beautiful people harms the people who are already beautiful and so may not increase aggregate social welfare.

It might seem obvious that since medical care is heavily subsidized, and obesity increases morbidity and mortality (see, e.g., K. Narbro et al. (1996)), taxing obesity in some fashion would be bound to reduce a negative externality. But this ignores the fact that reducing mortality increases the fraction of the population that is elderly, and the elderly not only consume a disproportionate fraction of medical expenditures but are more heavily subsidized for those expenditures than younger people.

There are two tradeoffs here: one between health expenditures per period and the number of periods (that is, the length of life), and the other between the subsidized and the nonsubsidized fraction of health expenditures. Suppose that taxing obesity would reduce average per-period medical expenditures by 10 percent but increase average length of life by 5 percent; then lifetime medical expenditures would fall by approximately 5 percent. But suppose further that the percentage of lifetime expenditures subsidized would increase—because more people would be living to Medicare-eligibility age—from 20 percent to 30 percent. Then the size of the net subsidy would increase by roughly 40 percent.

A further consideration is that efforts to lose weight impose their own health costs. Apart from the direct costs of diet pills and the like, there is the indirect cost of eating disorders and dangerous weight loss brought about by efforts to lose weight (see e.g., Flynn (1997)).

Notice that if obesity did create a negative externality, the current campaign to reduce smoking would be perverse, since

smoking is a method of weight control. From the standpoint of controlling weight, smoking should be subsidized rather than taxed. Notice also that since smoking and obesity are substitutes, we can expect cigarette producers to join with meat producers in opposing the taxing of obesity, since an increase in obesity would stimulate the demand for cigarettes.

Overall, one may argue that the case has not been made that obesity generates negative externalities large enough to justify government intervention to reduce its prevalence. The case has certainly been made that weights deviate from those medically optimal. But so does any other behavior that involves health risks, such as driving on highways, and we do not want to reduce the benefits of those behaviors even though they entail costs. At the very least, public measures should be discussed in light of an understanding of why private behavior have induced the observed growth in obesity over time.

Section 5: Concluding Remarks

This paper attempts to analyze the forces contributing to the worldwide long-run rise in obesity and the role of public interventions in affecting its continued growth. A growth in obesity in a population must result from growth of calorie consumption outpacing growth of physical activity. This paper considered the economic incentives that give rise to such a growth in obesity by stimulating intake of calories at the same time as discouraging spending these calories on physical activity.

We argued that technological change provided a natural interpretation of these long-run changes but that it also implies that obesity growth is self-limiting.

Our analysis suggests several avenues of future research. The first would be to assess empirically the extent to which physical activity on the job has affected obesity. This may be done with available data sets (such as The Nutrition and Health Examination Surveys (NHANES) in the US) by looking across occupational categories at how people have changed their food consumption and total physical activity, whether on or off the job activity. Such an analysis should also address the limited ability of the changed

incentives for on the job exercise to explain the rise in obesity among children.

Second, our analysis was limited in its predictions on gender differences in weight and the role of matching markets in determining weight. If weight affects one's ability to match, we would expect unmarried people today, as searchers in the marriage market, to be thinner than married people, implying that the rise in the age of marriage and the rate of divorce in recent decades has actually increased the average (physical) health of the population. The problem in attributing too large a role to matching markets is that rising divorce rates would imply a decline in obesity. In addition, rational expectations would tend to limit the value of temporary reductions in weight at the initial phase of the match.

It is empirically true and interesting that women are more concerned with their weight than men and are more likely to be dieting (Brownell (1991), p. 4). The greater value of thinness to women than to men is reflected in studies that find a greater negative correlation between earnings and overweight for women than for men (see, e.g., Register and Williams (1990), Averett and Koreman (1996), and Pagán and Dávila (1997)). Since marriage can be viewed as a type of employment, each spouse being viewed as the other's employer, these studies imply that a wife's household "wage" is reduced more by obesity than her husband's household "wage" is. The reason is that men value physical attractiveness in women more than women value physical attractiveness in men (see, with specific reference to obesity, Sobal, Nicolopoulos, and Lee (1995)). Yet an unanswered question is, if thinness is more valuable to women than to men, why are more women overweight (see Rodin (1993))?

A particularly interesting case concerns African American women, a much higher percentage of whom than of white women (49.2 percent versus 33.5 percent) are overweight (VanItallie (1996), p. 891 (tab. 2) and Chitwood et al. (1996)). There are two possible economic reasons to expect black women to be more obese on average than white even after correction for other differences, such as genetic (Argyropoulos (1998)). The first is that among poor people, who in this country are disproportionately black, thinness continues to be a signal of possible poor health or bad habits—drug addicts, alcoholics, people with AIDS, and homeless people tend to be thin because of malnutrition or disease. It is not surprising,

therefore, that although there is a positive correlation in the black community between slenderness and attractiveness (see Riley (1998), Harris (1995), and Thomas (1988)), black women have higher weight ideals than the ultrathin ideals held by white women (Flynn (1996)). Second, the marriage market is badly stacked against black women (Mullin (1998); Philipson and Posner (1993), pp. 75–78). This could incite even greater efforts of some women to achieve attractiveness, but it would reduce the gains from attractiveness to those women who had very poor marital prospects even with an incremental increase in attractiveness. When young black marriageable men are hard to find, the matching incentive for weight control of black women is reduced.

Lastly, empirical analysis has focused on the average behavior of weight over time and populations. Given that, by definition, obesity concerns the tail of the weight distribution, future analysis may fruitfully address whether the average tendencies in the population mimic the behavior in those tails. For example, it may be that there are offsetting changes in food consumption for the bottom and top part of the distribution that masks much of the data that focus on average behavior.

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