# Why Have Americans Become More Obese

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# Why Have Americans Become More Obese?

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In the early 1960s, the average American adult male weighed 168 pounds. Today, he weighs nearly 180 pounds. Over the same time period, the average female adult weight rose from 143 pounds to over 155 pounds (U.S. Department of Health and Human Services, 1977, 1996). In the early 1970s, 14 percent of the population was classified as medically obese. Today, obesity rates are two times higher (Centers for Disease Control, 2003).

Weights have been rising in the United States throughout the twentieth century, but the rise in obesity since 1980 is fundamentally different from past changes. For most of the twentieth century, weights were below levels recommended for maximum longevity (Fogel, 1994), and the increase in weight represented an increase in health, not a decrease. Today, Americans are fatter than medical science recommends, and weights are still increasing. While many other countries have experienced significant increases in obesity, no other developed country is quite as heavy as the United States.

What explains this growth in obesity? Why is obesity higher in the United States than in any other developed country? The available evidence suggests that calories expended have not changed significantly since 1980, while calories consumed have risen markedly. But these facts just push the puzzle back a step: why has there been an increase in calories consumed? We propose a theory based on the division of labor in food preparation. In the 1960s, the bulk of food preparation was done by families that cooked their own food and ate it at home. Since then, there has been a revolution in the mass preparation of food that is roughly comparable to the mass

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production revolution in manufactured goods that happened a century ago. Technological innovations—including vacuum packing, improved preservatives, deep freezing, artificial flavors and microwaves—have enabled food manufacturers to cook food centrally and ship it to consumers for rapid consumption. In 1965, a married women who didn't work spent over two hours per day cooking and cleaning up from meals. In 1995, the same tasks take less than half the time. The switch from individual to mass preparation lowered the time price of food consumption and led to increased quantity and variety of foods consumed.

Our theory is nicely illustrated by the potato. Before World War II, Americans ate massive amounts of potatoes, largely baked, boiled or mashed. They were generally consumed at home. French fries were rare, both at home and in restaurants, because the preparation of French fries requires significant peeling, cutting and cooking. Without expensive machinery, these activities take a lot of time. In the postwar period, a number of innovations allowed the centralization of French fry production. French fries are now typically peeled, cut and cooked in a few central locations using sophisticated new technologies. They are then frozen at −40 degrees and shipped to the point of consumption, where they are quickly reheated either in a deep fryer (in a fast food restaurant), in an oven or even a microwave (at home). Today, the French fry is the dominant form of potato and America's favorite vegetable. This change shows up in consumption data. From 1977 to 1995, total potato consumption increased by about 30 percent, accounted for almost exclusively by increased consumption of potato chips and French fries.

The technical change theory has several implications, which we test empirically. First, increased caloric intake is largely a result of consuming more meals rather than more calories per meal. This is consistent with lower fixed costs of food preparation. Second, consumption of mass produced food has increased the most in the past two decades. Third, groups in the population that have had the most ability to take advantage of the technological changes have had the biggest increases in weight. Married women spent a large amount of time preparing food in 1970, while single men spent little. Obesity increased much more among married women. Finally, we show that obesity across countries is correlated with access to new food technologies and to processed food. Food and its delivery systems are among the most regulated areas of the economy. Some regulations are explicit; for example, the European Union has taken a strong stance against genetically engineered food, and Germany for many years had a Beer Purity Law. Other "regulations" are cultural, like Jose Bove's crusade against McDonald's in France. Countries with a greater degree of regulation that support traditional agriculture and delivery systems have lower rates of obesity.

While the medical profession deplores the increase in obesity, the standard economic view is that lower prices for any good—either monetary or time costs—expand the budget set and make people better off. But self-control issues complicate this interpretation. If people have difficulty controlling how much they eat, lowering the time costs of food consumption may exacerbate these problems. Certainly, the $40–$100 billion spent annually on diets testifies to the self-control problems that many people face. In the last part of the paper, we consider the welfare implication of lower food production costs when individuals have self-control problems. We will argue that for the vast majority of people, the price reductions in food preparation have led to welfare increases.

## Trends in Obesity

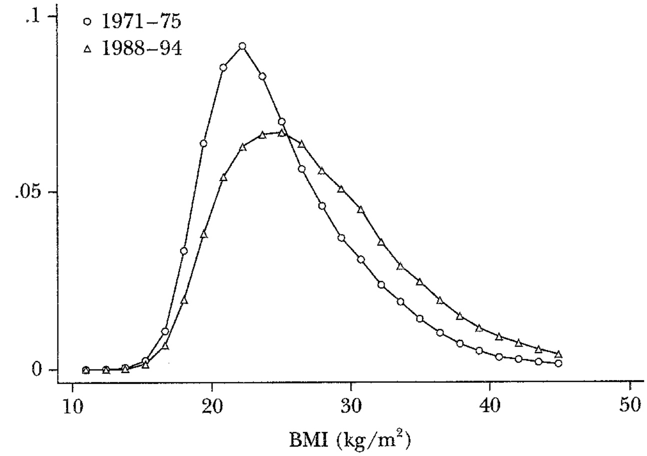
We make extensive use of the health and weight data from the National Health and Nutrition Examination Surveys (NHANES) that were conducted in 1959–1962, 1971–1975, 1976–1980, 1988–1994 and 1999–2001. We present data through 1999 where we can, but conduct most of our detailed analysis using data through 1994. The NHANES data measure height and weight directly, using mobile research vans, so obesity calculations are exact. This method is increasingly important as more people are overweight and embarrassed to admit it. The available, if somewhat sporadic, historical data on heights and weights has been compiled by Costa and Steckel (1997).

The primary measure of obesity is Body Mass Index, or BMI, which allows comparisons of weight holding height constant. BMI is measured as weight in kilograms divided by height in meters squared. Optimal BMI levels are generally believed to lie between 20 and 25. BMI below 20 is considered thin, BMI between 25 and 30 is overweight, and BMI above 30 is obese. A six-foot-tall man would therefore be overweight at 184 pounds and obese at 221 pounds. The medical evidence shows increasingly high rates of disease and death as BMI increases above 25 (World Health Organization, 2000; Sturm, 2002).[1]

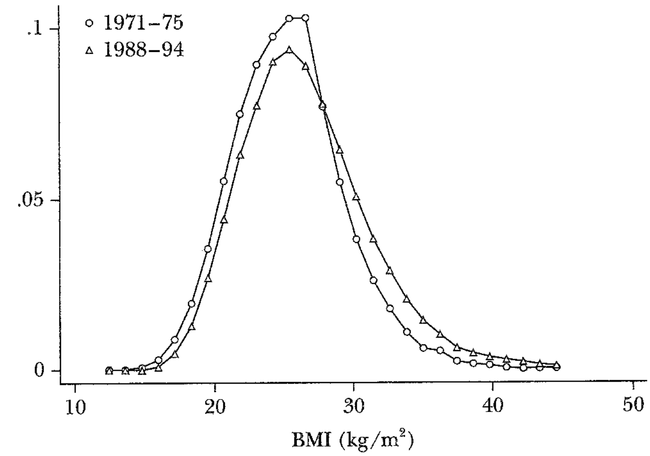
Early in the twentieth century, Body Mass Index was either optimal medically or too low, depending on the country (Costa and Steckel, 1997; Fogel, 1994). Between 1894 and 1961, average BMI for men in their 40s increased from 23.6 to 26.0, with a somewhat smaller, but comparable, increase for men in their 30s. The increase for men in their 40s corresponds to roughly 16 pounds for a typical American male (five feet, nine inches tall). Fogel (1994) shows that increases in BMI over the past few centuries were a major source of improved health. However, since 1960, BMI has increased by another 0.7. The weight increases in the more recent period are substantially less healthy than in the earlier time period. An average BMI above 25 places a large share of people in the medically overweight category. Over the past four decades, the share of the population that is either overweight or obese increased from 45 to 61 percent. The share of people that are obese increased from 13 percent to 27 percent. Obesity has increased for both men and women. For both men and women, most of this increase is in the 1980s and 1990s, and our analysis will focus on this period, as well.

[1] But see Campos (2003) for a reevaluation of this evidence.

*Figure 1*
**Distribution of BMI, 1971–1975 and 1988–1994**
**Males, age 20–55**




**Females, age 20–55**




*Source:* National Health and Nutrition Examination Surveys.

## The Demographics of U.S. Obesity

Not only is average weight increasing, but the right tail of the distribution is expanding particularly rapidly. Figure 1 shows the distribution of the Body Mass Index between the 1971–1975 and 1988–1994 surveys. Over this time, median BMI increased by 0.9; the 75$^{th}$ percentile increased by 1.5; and the 95$^{th}$ percentile increased by 2.7. While eating disorders, such as anorexia nervosa, are believed to have increased over the past 30 years (Hsu, 1996), the prevalence of this disease is still very low. We do not find a significant increase in the population with very low weight even among younger women. The U.S. Surgeon General estimates that

*Table 1*
**Increase in Weight by Population Group**

| | *Average BMI ($kg/m^2$)* | | *Percentage Obese ($BM \geq 30$)* | |
|---|---|---|---|---|
| | *1971–75* | *1988–94* | *1971–75* | *1988–94* |
| Average | 25.4 | 27.3 | 16% | 30% |
| Adults | | | | |
| All | 25.0 | 27.1 | 15 | 28 |
| Single male | 24.4 | 25.5 | 9 | 18 |
| Married male, nonworking spouse | 25.6 | 27.1 | 13 | 26 |
| Married male, working spouse | 25.7 | 27.3 | 11 | 24 |
| Single female | 24.9 | 27.4 | 18 | 32 |
| Married female, working | 24.3 | 27.4 | 13 | 33 |
| Married female, not working | 24.9 | 28.0 | 16 | 36 |
| Elderly | | | | |
| All | 26.1 | 27.6 | 19 | 32 |
| Male | 25.4 | 27.0 | 13 | 28 |
| Female | 26.7 | 28.2 | 25 | 36 |
| Women aged 20+, by education group | | | | |
| <High school | 26.3 | 28.4 | 24 | 38 |
| High school | 24.2 | 27.5 | 13 | 33 |
| College or more | 22.8 | 25.4 | 7 | 20 |
| Men aged 20+, by education group | | | | |
| <High school | 25.6 | 26.5 | 15 | 23 |
| High school | 25.7 | 26.7 | 13 | 24 |
| College or more | 25.2 | 26.4 | 8 | 21 |

*Notes:* Data are from the National Health and Nutrition Examination Survey (NHANES). BMI is measured in $kg/m^2$.

around 0.1 percent, or 300,000 people, suffer from anorexia nervosa (U.S. Department of Health and Human Services, 1999).

Table 1 shows data on obesity for adults. The left columns report average BMI; the right columns report the share of the population that is obese. The average increase in BMI between the 1970s and the 1990s, shown in the first row, is 1.9. There are some differential increases in obesity by demographic group, which we examine later in the paper. As a preview of these later arguments, married women and women with exactly 12 years of schooling have had the largest increases in average BMI. These groups traditionally spent a lot of time preparing meals at home, and they spend less time now. However, Table 1 also provides some first evidence that increased obesity is not a result of women working. Holding constant obesity within demographic groups, the shift to more households with women working can account for no more than 10 percent of increased obesity (Cutler, Glaeser and Shapiro, 2003).[2]

[2] But see Chou, Grossman and Saffer (2002), who argue that increased labor market attachment has played an important role in the rise of obesity in the United States.

The bottom rows of Table 1 show changes in obesity by education group, separately for men and women. Obesity for women is strongly negatively associated with education. This was true in the early 1970s and continues to be true today. But obesity has increased for all education groups. For men, obesity is relatively independent of education and has been for the past few decades. These trends belie an obvious income-based explanation for increasing obesity. Higher incomes, at least as reflected in increased education, would actually lower obesity. In Cutler, Glaeser and Shapiro (2003), we confirm in a regression framework that trends in education, age, race, marital status, employment, occupation and the employment status of the spouse of the head of the household explain at most 10 percent of the increase in BMI and obesity over this time period. Demographic change is not the explanation here.

### International Evidence on Obesity

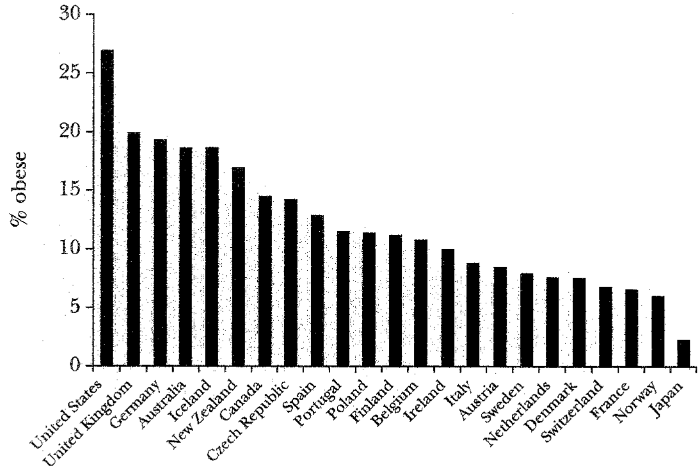
Figure 2 puts the U.S. experience in international perspective, showing data on obesity in OECD countries. The United States is a clear outlier, but other countries are heavy, as well. Obesity levels in several former Warsaw Pact countries are nearly as high as they are in the United States. Obesity in England is also extremely high. France, Italy and Sweden rank much lower in their obesity levels, and the Japanese are quite thin.

Data on changes in obesity across countries are harder to find. Some countries have scattered information, discussed in Cutler, Glaeser and Shapiro (2003). The increase in obesity in the United Kingdom is similar to that of the United States, although it starts from a lower level. Australia has also seen a rise in obesity, although not as large. Canada, a country that one might think would parallel the U.S. experience, had much more modest increases in obesity for men and a decrease in obesity for women between 1978 and 1988, although obesity has increased since then (Katzmarzyk, 2002). A good theory of the changes in obesity should be able to explain why obesity has risen so much in some countries and so little in others.

## Calories In versus Calories Out

Arithmetically, people get heavier if they consume more calories or expend fewer calories. On average, about 3,500 calories is one pound. There are differences in metabolisms across human beings, and it is also possible that different caloric expenditures may have different impacts on the amount of weight gained or lost. But for a typical person, an increase in calorie consumption of 3,500 calories or a reduction in caloric expenditure of that amount increases weight by one

*Figure 2*
**Obesity in International Perspective**




*Source:* OECD Health Statistics (2000).

pound.[3] In this section, we evaluate which of these factors explains changes in obesity.

We start with some basic energy accounting. People burn calories in three ways. The first is through basal metabolism—the energy cost associated with keeping the body alive and at rest. Basal metabolism represents about 60 percent of energy utilization for most people. The energy cost of basal metabolism depends on weight: $BMR = \alpha + \beta * Weight$. The more a person weighs, the more energy is required to sustain basic bodily functions. Schofield, Schofield and James (1985) estimate values of $\alpha$ of 879 for men and 829 for women, and $\beta$ of 11.6 for men and 8.7 for women (ages 30–60). Different age groups are associated with different values of these parameters, and the parameters may also vary somewhat with conditions. However, the substance of our conclusions is unchanged under reasonable alternative assumptions. A 70 kilogram (155 pound) man burns on average about 1,800 calories before he does any activity. A 60 kilogram woman (132 pounds) burns about 1,400 calories.

The second source of energy expenditure is that processing food requires energy. This "thermic effect" is about 10 percent of total energy expenditures during a day and comes from the thermic effect of food.

Finally, calories are burned by physical activity. The caloric needs of a given amount of physical activity is proportional to weight: $Energy = \Sigma_a \, \eta_a \cdot Weight \cdot$

[3] There has been controversy in recent years over whether other variables, such as the fat or carbohydrate composition of food, may also influence weight patterns (Atkins, 2000). Given the lack of scientific consensus on the importance of energy composition (Bhargava and Guthrie, 2002; Fumento, 2003), we ignore these issues in this paper.

$Time_a$, where $\eta_a$ varies with the activity done, $a$. The units of $\eta_a$ are calories per kilogram-minute, so $\eta_a$ gives a translation between the weight of the individual and the duration of activity and the total caloric expenditure associated with the activity. In this literature, $\eta_a$ is typically grouped into categories such as light activity, such as walking or light housework, moderate activity, such as fast walking and gardening, and heavy activity, like strenuous exercise or farm work (Ainsworth et al., 1993). Summing across activities, we denote an exercise index $E = \Sigma_a \eta_a Time_a$, reflecting total physical activity in a period of time.

In steady-state, calories in equal calories out. Denoting $K$ as daily calories consumed, this implies a weight equation of the form

$$K = \alpha + (\beta + E) * Weight + .1 * K.$$

Using estimates of $\beta$ and $E$ from the literature (Schofield, Schofield and James, 1985; Whitney and Cataldo, 1983), this equation can be used to estimate that the 10- to 12-pound increase in median weight we observe in the past two decades requires a net caloric imbalance of about 100 to 150 calories per day.

These calorie numbers are strikingly small. One hundred and fifty calories per day is three Oreo cookies or one can of Pepsi. It is about a mile and a half of walking. Given the small size of this change, it is obviously difficult, if not impossible, to determine exactly what explains it. The detailed data on dietary habits and activities that would be needed to examine this question do not exist. Accordingly, we use more indirect measures to infer the causes of rising weight. We discuss evidence on changing intake first and then turn to energy expenditure.

## Evidence on Caloric Intake

There are two sources of data on food intake: food recall studies and agricultural sales data. Detailed food recall data are available for 1977–1978 and 1994–1996 from the Continuing Surveys of Food Intake by Individuals, conducted by the U.S. Department of Agriculture.[4] In a food recall study, respondents detail everything they ate in the previous 24-hour period. In principle, all food consumption is recorded. In practice, consumption is surely understated, as people do not record everything they eat. For example, the average male in 1994–1996 reports consuming 2,347 calories, and the average female reports consuming 1,658 calories. These imply steady-state weights considerably below those measured for the same popu-

[4] In food recall studies, respondents are contacted and asked to recall all food eaten in the previous two-hour period. Respondents are then asked to keep detailed food diaries for the next one or two days. Consistent with other researchers, we use consumption information from only the first day, although these too are believed to be underreported (Enns, Goldman and Cook, 1997).

*Table 2*
**Changes in Food Consumption, 1977–1978 to 1994–1996**

| | Meal | Calories[a] 1977–1978 | Calories[a] 1994–1996 | Change | Percentage of Total Change |
|---|---|---|---|---|---|
| Male | TOTAL | 2080 | 2347 | 268 | 100% |
| | Breakfast | 384 | 420 | 36 | 13 |
| | Lunch | 517 | 567 | 50 | 19 |
| | Dinner | 918 | 859 | −59 | −22 |
| | Snacks | 261 | 501 | 241 | 90 |
| | Calories per meal | 573 | 566 | −7 | |
| | Meals per day | 3.92 | 4.53 | .61 | |
| Female | TOTAL | 1515 | 1658 | 143 | 100% |
| | Breakfast | 286 | 312 | 26 | 18 |
| | Lunch | 368 | 398 | 31 | 22 |
| | Dinner | 676 | 602 | −74 | −52 |
| | Snacks | 186 | 346 | 160 | 112 |
| | Calories per meal | 422 | 408 | −14 | |
| | Meals per day | 3.86 | 4.44 | .58 | |

*Note:* Data are from the Continuing Survey of Food Intake 1977–1978 and 1994–1996.
[a]Average calories except for the row reporting average meals per day.

lation. Underreporting is not necessarily a problem for our analysis, if the extent of underreporting is constant over time, but as surveys have improved, underreporting has likely fallen.

Table 2 shows changes in food consumption between the mid-1970s and the mid-1990s for males and females. The top row in each panel reports overall caloric intake. Reported consumption increased by 268 calories for men and 143 calories for women between the two surveys. This increase is more than enough to explain the increase in steady-state weight.

The rows of the table show the distribution of those calories by meal. Somewhat surprisingly, most of the increase in calories is from calories consumed during snacks. Dinnertime calories have actually fallen somewhat. The increase in caloric intake is because of greater frequency of eating, not eating more at any one sitting. In calculations not shown in the table, we find that the number of snacks in the typical day increased dramatically over this period. Whereas only about 28 percent of people in 1977–1978 reported two or more snacks per day, 45 percent reported two or more snacks in 1994–1996. The average number of snacks per day increased by 60 percent over this period, thus more snacks per day—rather than more calories per snack—account for the majority of the increase in calories from snacks.

The finding that increased caloric intake is from more snacks rules out two obvious accounting explanations for increased obesity. The first is that obesity is a result of increased portion sizes in restaurants (Young and Nestle, 2002). If this theory were true, calories at main meals, particularly dinner, would have increased. Similarly, the evidence also rules out the view that fattening meals at fast food restaurants have made America obese. The food diaries also present evidence on where calories are consumed. Fast food has certainly increased, from about 60 calories per day to over 200 calories per day. But this increase is largely at formal meals, where it has been offset by reduced home consumption. The increase in snacks, in contrast, is largely concentrated in snacks consumed at home and, to a lesser extent, in snacks purchased in stores and restaurants.

We also examine data on food sales, taken from total production and adjusted for exports, imports and feed stock (U.S. Department of Agriculture, 2000). In recent years, the data have also been adjusted for wastage, although this adjustment is imprecise. Food supply declined relatively steadily between 1909 and 1950. There were significant downturns during World War I and the Great Depression and moderate declines in other periods. This decline is almost certainly related to reduced need for food, as people moved off of farms and into cities. The decline in food consumption helps to explain why obesity increased only mildly during this earlier time period, despite a large reduction in energy expenditures. Since 1965, however, food supply has increased markedly, particularly in the last two decades. In 1978, food supply was 3,200 calories per person. By 1999, food supply was 3,900 calories per person, 700 calories higher. Adjusted for wastage, the increase is 418 calories. This change is three to four times the increase that is needed to explain the increase in average obesity over the time period.

**Evidence on Energy Expenditure**

We examine two components of energy expenditure: voluntary exercise and involuntary energy expenditure associated with employment. Data on voluntary exercise come from time diary studies. As with food diaries, the very act of keeping the diaries induces some people to alter their behavior. Moreover, some of the data is retrospective, and there are natural memory problems. People may lie, as well. Still, these problems may not bias trends in time allocation, which is our concern.

Table 3 displays information on time usage in 1965, 1975, 1985 and 1995. Time use has been remarkably stable over time. The biggest change occurred between 1965 and 1975, when television watching increased by 40 minutes. Some of the increase in TV time appears to have come out of other forms of socializing (Putnam, 2000) and a decline in meal cleanup activities. Using our energy expenditure equation above, we calculate that a 40-minute change from light household activity to sedentary activity would lead to a four-pound increase in steady-state weight for the average male.[5] However, since 1975, television viewing has increased by 22 minutes, half of the increase in the previous decade. Furthermore, this rise in TV viewing has been offset by a decline in other passive categories, such as sleeping, and an increase in more active categories, such as sports or walking. At the bottom of Table 3, we calculate values of $E$—the energy expenditure index—for the

[5] Forty minutes of sedentary activity burns about 50 kilocalories for a 70 kg man (Ainsworth et al., 1993). Light household activity uses about 70–90 kilocalories for the same person (Ainsworth et al., 1993), corresponding to a difference of about 20–40 kilocalories, or 2–4 pounds, in steady state.

*Table 3*
**Time Use, 1965–1995**
*(Minutes per day, age 18–64)*

| *Activity* | *1965* | *1975* | *1985* | *1995* |
|---|---|---|---|---|
| Paid work | 290 | 258 | 259 | 266 |
| Eating on the job | 11 | 8 | 8 | — |
| Breaks | 8 | 4 | 3 | 1 |
| Household work | 146 | 128 | 124 | 102 |
| Food preparation | 44 | 41 | 39 | 27 |
| Meal cleanup | 21 | 12 | 10 | 4 |
| Child care | 37 | 31 | 31 | 18 |
| Obtaining goods and services | 51 | 45 | 53 | 49 |
| Personal needs and care | 622 | 644 | 634 | 632 |
| Meals at home | 58 | 54 | 50 | 65 |
| Meals out | 11 | 19 | 19 | (meals at home & out) |
| Sleeping/napping | 473 | 496 | 479 | 495 |
| Education and training | 12 | 16 | 18 | 23 |
| Organizational activities | 20 | 24 | 18 | 17 |
| Entertainment/social | 78 | 65 | 65 | 72 |
| Recreation | 27 | 37 | 43 | 47 |
| Active sports | 5 | 4 | 10 | 13 |
| Outdoor | 1 | 7 | 5 | 6 |
| Walking/hiking/exercise | 1 | 2 | 4 | 5 |
| Communication | 158 | 191 | 195 | 212 |
| TV | 89 | 129 | 129 | 151 |
| TOTAL | 1440 | 1440 | 1440 | 1440 |
| Kcal per minute per kilogram | 1.69 | 1.57 | 1.62 | 1.53 |
| $E$ for 70 kilogram man | 16.4 | 13.5 | 14.7 | 12.6 |
| $E$ for 60 kilogram woman | 15.1 | 12.3 | 13.5 | 11.3 |

*Notes:* Time use data from Robinson and Godbey (1997) and authors' calculations from 1995 time diary. Energy expenditure data from authors' calculations based on Compendium of Physical Activities.

different time periods. The estimated value of $E$ fell between 1965 and 1975, but has been quite stable since then. We cannot explain changes in obesity in the past two decades on that basis.

The second component of energy expenditure is energy spent on the job and commuting to work. Philipson and Posner (1999) stress this hypothesis in explaining the increase in obesity over time. This view is certainly true over the longer run. Between 1910 and 1970, the share of people employed in jobs that are highly active like farm workers and laborers fell from 68 to 49 percent. Since then, the change has been more modest. Between 1980 and 1990, the share of the population in highly active occupations declined by a mere 3 percent, from 45 to 42 percent. Occupation changes are not a major cause of the recent increase in obesity.

Changes in transportation to work are another possible source of reduced energy expenditure—driving a car instead of walking or using public transportation. Over the longer time period, cars have replaced walking and public transportation as means of commuting. But this change had largely run its course by 1980.

In 1980, 84 percent of people drove to work, 6 percent walked and 6 percent used public transportation. In 2000, 87 percent drove to work, 3 percent walked and 5 percent used public transportation (U.S. Department of Commerce, 2000). Changes of this minor magnitude are much too small to explain the trend in obesity: for a 70 kilogram man with a typical commute time of around 22 minutes, this change would lead to an increase of less than 0.4 pounds in steady state.

A final piece of evidence on energy expenditure comes from examining population subgroups. Children and the elderly do not work now, and they did not work in 1980. However, the data show large increases in obesity among children and adolescents.[6] Further, the elderly may be more active now than in 1980, yet they are also more obese now than in 1980.

In sum, our results suggest that the most plausible explanation for the rise in obesity involves increased caloric intake, not reduced caloric expenditure. Given the limitations of the evidence, we cannot be certain that this completely explains the rise in obesity. However, we will accept this conclusion and turn next to theories of why caloric consumption has increased so greatly.

## Technology, the Division of Labor and Obesity

Several theories could potentially explain the increase in caloric intake over the past 25 years. Price and income changes are one explanation. As people get richer, they will demand more food. But income changes seem unlikely to explain our results. Income and obesity are negatively associated today, at least for women. Furthermore, for much of the period, real incomes were not increasing greatly at the bottom of the income distribution, but obesity for those groups still increased. Relative price declines for food could also explain increased consumption. However, from 1970 to 1999, the Consumer Price Index for food items increased only 3 percent slower than the CPI for nonfood items.

We also reject a theory of obesity that the increased numbers of women at work have increased the demand for eating out—and for eating less healthy food. As we argued above, increased female labor force participation does not appear linked to rising obesity. Furthermore, it is not clear that eating out should increase caloric intake. Restaurants can cook low-calorie food just as easily as high-calorie food. Indeed, substitution of dinners from home cooked to eaten out seems not to have increased caloric intake at dinner.

Here, we propose a new theory of increased obesity based on reductions in the time cost of food, which in turn has allowed more frequent food consumption of greater variety and, thus, led to higher weights.

[6] Anderson, Butcher and Levine (2002) offer evidence that children of working mothers are more likely to be overweight than children of nonworking mothers, although this effect explains only a small portion of the total increase in child overweight in the last 30 years.

**The Rise of Mass Preparation**

Traditionally, consumers took raw agricultural products and transformed them into edible food. This preparation involved significant amounts of time. As late as the 1960s, a majority of the total costs of food were preparation and cleanup time. In 1965, the average family spent $15 per day on purchased food (in 1990 dollars) and about 130 minutes on preparation and cleanup (Robinson and Godbey, 1997). At an average wage for women, this time cost perhaps $20, or 57 percent of total food expenditures. Over the past 30 years, the time involved in preparing food has fallen in half.

People could always make almost any form of food that is currently available, if they were willing to spend the time to do so. For example, ambitious cooks could make snack-size cream-filled cakes, for example, but it took time. Technological innovations since 1970 mean that preparation can now be done in restaurants and factories, exploiting technology and returns to scale. Snack-size cream-filled cakes are now widely available for less than a dollar.

To produce food in one location that will be nearly ready for consumption in another location, one must surmount five main technological obstacles (Kelsey, 1989): controlling the atmosphere; preventing spoilage due to microorganisms; preserving flavor; preserving moisture; and controlling temperature. Innovations in food processing and packaging over the last three decades have improved food manufacturers' ability to address each of these issues.

"Controlled atmosphere processing" and, more recently, "modified atmosphere processing," allow food manufacturers to control the gaseous environment in which their foods are stored. In the case of fruits, vegetables and other foods with living cells, these technologies slow down ripening and prevent spoilage. For recently introduced packaged goods such as fresh pasta, prepared salads and cooked chicken, control of the atmosphere inside the package can greatly lengthen shelf life (Testin, 1995).

Hydrogen-peroxide sterilization (approved for use in 1981) and stretch-wrap films (introduced in 1976) have improved food producers' ability to kill and seal out harmful microorganisms. Since the 1970s, food irradiation has made significant advances, although the diffusion of this technology has been slowed by public concern and the Food and Drug Administration.

A persistent problem in food processing is that packaging can adversely affect food flavor. The 1980s saw huge advances in "flavor barrier" technology, which involves materials specially tailored to the food that prevent migration of flavor-related chemicals to and from the food. In addition, the food industry has increasingly made use of chemists as flavor specialists to design food flavors to suit consumers' tastes (Schlosser, 2002). These chemists hone in on what makes certain foods desirable and synthesize it in the laboratory. These artificial flavors can then be added to make pre-prepared food more appealing.

Temperature and moisture pose a particular problem in the case of frozen foods. If moisture builds up in the package, ice crystals can form, which separate ingredients and alter the food's texture (Kelsey, 1989). In addition, moisture can lead to dehydration of food in the freezer and "freezer burn." Advances in polyethylene plastics and other materials have improved control over the internal moisture of food packages, thus extending the freezer/shelf life of many foods and improving flavor.

Other technologies are available at the user end. Microwaves were developed in the 1940s as an outgrowth of radar technology and became widely available in the 1970s. As late as 1978, only 8 percent of American households had microwaves. By 1999, 83 percent of American households had microwave ovens (Energy Information Administration, 2003, provides more details). Other kitchen appliances, such as refrigerators, have also improved.

These technologies did not affect all foods or all places equally. Generally, foods that are consumed in more or less the same form that they leave the farm, like fresh fruit, stand to gain less from advances in packaging and processing. Foods that involve significant amounts of preparation benefit most from the new technologies.

American technological leadership and the large size of the American market meant that many of the most important innovations were first developed in the United States. Other countries have often limited the incursions of American food products or food retailers (such as fast food outlets). Moreover, food is often one of the most regulated areas of any the economy, and many economies have put substantial roadblocks to the incorporation of new food technologies.

Perhaps the most telling evidence for the revolution in time costs of food production has been the reduction in the time spent cooking and cleaning. Table 4 shows food preparation times for different subgroups of the population in 1965 and 1995. The food preparation and clean-up times for both working and nonworking women fell by about 50 percent. These changes hold work status constant. They reflect technology, not labor force participation.

The trend toward increased levels of commercial preparation also appears in data on the distribution of food payments. In 1972, 44 percent of the cost of food went to farmers. By 1997, only 23 percent of the cost of food represented the input of farmers. The rest is input from the retail sector. This statement does not just apply to the restaurant sector. Eighty percent of the cost of food eaten at home is now spent on nonfarm related expenses. Labor in the supermarket and the factory has replaced labor in the home, and this shift has been associated with dramatic time savings within the home.

**Implications of Technological Change**

Food preparation involves both fixed and variable costs. For example, peeling and cutting French fries is a marginal time cost, while deep frying is generally a fixed cost (up to the point where the fryer is full). Mass preparation means that the fixed time component can be shared over a wide range of consumers. In addition, mass preparation reduces the marginal cost of preparing food by substituting capital for labor. Finally, mass preparation exploits the division of labor. Food professionals instead of everyday people now prepare food, reducing both fixed and marginal costs.

*Table 4*
**Time Costs by Demographic Group**
*(minutes)*

| | *1965* | | *1995* | |
|---|---|---|---|---|
| | *Meal Prep.* | *Meal Prep. + Cleanup* | *Meal Prep.* | *Meal Prep. + Cleanup* |
| Adults | | | | |
| Single male | 13.6 | 18.1 | 15.5 | 17.3 |
| Married male, nonworking spouse | 6.5 | 9.4 | 13.2 | 14.4 |
| Married male, working spouse | 8.1 | 11.9 | 13.2 | 14.4 |
| Single female | 38.1 | 60.1 | 28.9 | 33.1 |
| Married female, working | 58.3 | 84.8 | 35.7 | 41.4 |
| Married female, not working | 94.2 | 137.7 | 57.7 | 68.8 |
| Elderly | | | | |
| Male | 16.6 | 26.3 | 18.5 | 20.2 |
| Female | 65.9 | 10.4 | 50.1 | 60.3 |

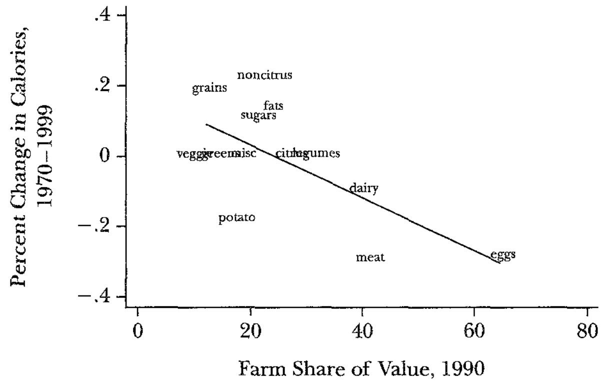
*Source:* Authors' calculations from Americans' Use of Time Survey Archives, 1965 and 1995.

Reductions in the time cost of food preparation should lead to an increase in the amount of food consumed, just as reductions in any good's price should lead to increased consumption of that good. Based on a standard quantity-quality model of food consumption, as in Becker and Lewis (1973), this increase can occur through several channels: 1) increased variety of foods consumed; 2) increased frequency of food consumption; 3) a switch to high-calorie/high-flavor prepared foods that had previously been unavailable; or 4) an increase in the overall consumption of each individual food item. As fixed costs decline, we would expect most of the increase in calories to come from increased variety of foods and frequency of food consumption, rather than more food during each meal. Indeed, reductions in time costs have an ambiguous effect on calories per food item. If the quantity of meals and food at each meal are substitutes (for example, as people become sated), the calories at any given meal will decline.

## Testing the Implications of the Theory

The mass preparation theory suggests four empirical implications. First, the lower costs of food preparation mean that individuals should consume a wider range of products at more times during the day. Second, the increase in food consumption should come mostly in foods that had an improvement in mass preparation technology (and complements to those foods). Third, individuals who have taken the most advantage of the new technologies should have had the biggest increase in obesity. Finally, obesity rates should be higher in countries with greater

*Figure 3*
**Food Preparation and Changes in Intake**




*Notes:* Data on calories for each food group are from the Per Capita Food Consumption Data System (2002). Data on farm share of value were obtained by personal correspondence with Howard Elitzak of the United States Department of Agriculture, Economic Research Service. The regression equation is $\Delta$ ln(cals, 1970–1999) = 0.185 (.075) − 0.008 (.003) * farm share of value, 1990; $N = 13$, Adj. $R^2 = 0.409$

access to technological changes in food consumption. In this section, we test these implications.

### Implication 1: Changes in Food Type, Composition and Timing

A reduction in the time costs of food preparation should cause people to consume a greater variety of foods now than in the past and at more times during the day. We already noted the evidence for this point in Table 2. Snacks are where a significant portion of the changes in food production have occurred. Snacks are also largely pre-prepared.

### Implication 2: Calories from Different Food Products

Consumption should have increased most for food items that have experienced the most time-saving technological change. The best measure of the degree of mass preparation is the U.S. Department of Agriculture's measure of the share of costs going to farmers instead of other food preparers, called the "farm value share." Food items with a great deal of mass preparation have low farm values. The USDA has calculated the farm value share for some food categories: it varies greatly, from over 60 percent for eggs to near 10 percent for grains. Figure 3 shows the relationship between farm value share and caloric growth across 13 food categories. There is a relatively large and statistically significant negative correlation of −.68 between the two: food items with large amounts of commercial preparation have increased in consumption, and food items with less commercial preparation have fallen.

*Table 5*
**Time Costs and Changes in BMI**
*(Dependent variable: change in BMI, 1971–1975 to 1988–1994)*

| *Independent Variable* | *(1)* | *(2)* | *(3)* |
|---|---|---|---|
| Sex-specific time cost (min.), 1965 | 0.0155 | | |
| | (0.0027) | | |
| Household-specific time cost (min.), 1965 | | 0.0078 | |
| | | (0.0055) | |
| Change in sex-specific time cost, 1965–95 | | | −0.0182 |
| | | | (0.0050) |
| Constant | 1.3043 | 1.3774 | 1.7983 |
| | (0.1712) | (0.5134) | (0.1768) |
| Observations | 8 | 8 | 8 |
| Adjusted $R$-squared | 0.8156 | 0.1223 | 0.6336 |

*Notes:* Standard errors are in parentheses. Data on the change in BMI are from the NHANES surveys of 1971–1975 to 1988–1994. The initial time cost is from 1965, computed as minutes spent preparing and cleaning up after meals. The data are from the Americans' Use of Time Survey Archive.

**Implication 3: Changes in Obesity Across Demographic Groups**

Obesity should increase the most among groups for whom the costs of food production fell the most. Thus, the theory predicts that obesity should increase the most among groups who formerly made most of their food in the house and should have increased the least among groups that already ate out more.

To test this prediction, we relate changes in obesity across demographic groups to the amount of time spent preparing food in 1965 and to changes in the amount of time spent preparing food between 1965 and 1995. We divide the adult population into the eight demographic groups shown earlier in Table 4. An important issue is whether the time costs should be for the person or the family. Under the assumption of joint household decision making, it is the total time usage that matters, not the individual time spent. In other models, the time that each person spends in food preparation would matter. For example, if men eat at work in ways their wives cannot control, we would not expect reduced time costs for wives to have much effect on weight of married men.

Table 5 shows the relationship between the initial time spent preparing food and the change in BMI. In each column, we regress the change in BMI for each of the groups in Table 4 on the level or change in average time use for that group from 1965 to 1995. Column 1 shows the relationship where time spent in food preparation is calculated for the average individual in the group. In column 2, the time is calculated for the average household of individuals in the group. There is a positive relationship between time costs and obesity changes in column 1, but less so in column 2. Women spend less time preparing food now than they used to, and they are much more obese than they used to be. The difference between men and women may be related to the fact that variety has increased the most for women (men already ate out more) or to lack of joint decision making. The results in column 1 indicate that each 30 minutes of initial food preparation time is associated with an increase in BMI of nearly 0.5. This factor does not explain all of the increase in obesity—the constant is statistically significantly positive—but it explains a good share. Column 3 shows the relation between the change in BMI and the change in the time spent preparing food, using person-specific time costs. The results are similar: groups that saw a large reduction in the time spent preparing food also had large increases in BMI.

**Implication 4: Obesity Across Countries**

Reduced time for preparing food should have a greater effect in countries where the appropriate technological innovations are encouraged. Many countries have explicit or implicit restrictions on the ability of food producers or consumers to have access to such technologies. We examine whether such restrictions are related to obesity.

Evidence on household appliances certainly suggests that countries differ in their access to food preparation technology. While over 80 percent of U.S. households have microwave ovens, in Italy, where obesity is much less common than in the United States, only 14 percent of households have microwaves (Alberta Agriculture, Food, and Rural Development, 2003). By contrast, in the United Kingdom, which has obesity rates much closer to those of the United States, 66 percent of households have microwaves. Calculations of the time spent cooking in a typical day, based on the Multinational Time Use Study (2003) line up similarly. Controlling for basic demographics, Italian and French adults spend about 19 more minutes per day cooking than Americans, whereas those in the United Kingdom spend almost exactly the same amount of time as Americans.

Our sample, which is determined by the availability of data, is OECD countries.[7] Table 6 shows the results. In all of our regressions, we control for female labor force participation rates and GDP per capita, to test these theories of obesity. The first column includes just female labor force participation rates and income. Neither is significantly related to obesity, nor are they related when other variables are included. Ideally, we would have data directly on food industry regulation, but because such data are not always available, we use a number of proxies.

The second column includes the frequency of price controls in the economy as a whole. This variable is an average of the 1989 and 1994 *Economic Freedom of the World* index of price controls (Gwartney, Lawson and Block, 1995). The index ranges from 0 to 10. We have normalized it to have a mean of 0 and a standard deviation of 1. People in OECD countries with more price controls are much less obese than people in countries without price controls. A one standard deviation increase in price controls is associated with about 3.7 percentage points less obesity.

The third column looks at the relation between producer protection—measured as the ratio of agricultural prices in the country to and worldwide prices—and

[7] The appendix of our working paper, Cutler, Glaeser and Shapiro (2003), shows the countries included in each regression.

*Table 6*
**International Regressions**
*(Dependent variable: percentage of adult population that is obese)*

| *Independent Variable* | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* |
|---|---|---|---|---|---|---|---|
| Frequency of price controls[a] | | −3.7 | | | | | |
| | | (1.3) | | | | | |
| Producer protection[a] | | | −4.5 | | | | |
| | | | (1.7) | | | | |
| Number of food statutes[a] | | | | −7.4 | | | |
| | | | | (2.2) | | | |
| Civil law origin | | | | | −7.5 | | |
| | | | | | (2.2) | | |
| log(time to open business) | | | | | | −2.6 | |
| | | | | | | (1.1) | |
| Cost of a Big Mac (US2000$)[a] | | | | | | | −4.7 |
| | | | | | | | (2.3) |
| log(GDP per capita), 1998 | 0.68 | −4.63 | 6.78 | 5.10 | −1.58 | −4.72 | 10.65 |
| | (4.57) | (4.25) | (4.59) | (3.76) | (3.72) | (4.56) | (6.80) |
| % females in labor force, 1992 | 0.24 | 0.04 | 0.81 | 0.69 | 0.26 | −0.15 | 0.46 |
| | (0.31) | (0.27) | (0.66) | (0.41) | (0.25) | (0.31) | (0.47) |
| Constant | −0.35 | 22.73 | −42.96 | −31.42 | 11.15 | 39.75 | −39.30 |
| | (19.27) | (17.98) | (33.38) | (22.05) | (15.82) | (23.15) | (31.83) |
| Observations | 22 | 21 | 9 | 9 | 22 | 21 | 13 |
| Adjusted $R$-squared | −0.072 | 0.204 | 0.491 | 0.310 | 0.557 | 0.128 | 0.124 |

*Notes:* Standard errors are in parentheses. Appendix Table 3 shows the available countries and source of data.
[a]Data are standardized to have a mean of 0 and standard deviation of 1.

obesity. This variable comes from the OECD's *Producer and Consumer Support Estimates 1999* database. The measure captures tariff and nontariff barriers to agriculture, but is only available for nine countries. A one standard deviation increase in domestic prices above world prices reduces obesity by a statistically significant 4.5 percentage points. One possible concern is that this relationship is driven by pure price effects—higher food prices from protectionism would lead to lower consumption—but the strong correlation between our measure of protectionism and our other measures of regulation suggests that price effects are not the whole story.

The fourth column includes a count of the number of food laws listed in nine countries from Kellan and Guanino (2000). These laws include packaging and labeling requirements, preservative tolerances and pesticide regulations. The mean country for which data are available has 26 food laws. Although we have only nine observations, the few observations do suggest that countries with more food laws have lower levels of obesity.

Recent research has highlighted the link between regulation and the structure of the legal system (La Porta et al., 1999). Countries with a common law legal origin (the British model) are much less regulated than are countries with a civil law origin (the French model). The fifth column includes a measure of civil law legal origin to capture the overall prevalence of regulation. More regulated countries are 7 percent less obese than are less regulated countries.

One way that regulation works is to stop new technology. To measure the ease of technology importation, the sixth column relates obesity to the Djankov et al. (2002) measure of the time required in days to open a new business (in days). Countries with greater time delays to opening new businesses are less obese than countries with shorter times.

The last column relates obesity to the price of a Big Mac, taken from the *Economist.* Big Mac prices are an approximate measure of relative food costs in different countries. Countries in which Big Macs cost more are less obese than countries in which they cost less. Although Big Mac prices will presumably depend on demand as well as supply, if demand differences were the sole force behind the price heterogeneity, we would expect to see the opposite pattern: countries with higher prices having more obesity (assuming that supply is not perfectly elastic).

The results in Table 6 are not definitive, but they certainly support the theory. People in more regulated countries, and particularly countries with a more regulated agricultural sector, are less obese. Female labor force participation rates and real income are unrelated to obesity.

## Obesity, Self-Control and Consumer Welfare

Lower time costs of food preparation may affect consumption through two channels. The first is a standard price mechanism. The cost of food consumption includes time and money costs. As time costs fall, one would expect a standard demand response to price. This effect could be large enough to explain the increase in consumption we observe. Reductions in the time required to prepare food reduced the per calorie cost of food by 29 percent from 1965 to 1995. If the elasticity of caloric intake with respect to price is $-0.7$, this could explain the increase in caloric intake. An elasticity of $-0.7$ is possible, but probably on the high side. Typical price elasticities for total food consumption are on the order of $-0.6$ (Blundell, Browning and Meghir, 1994). The elasticity of caloric intake with respect to price is likely smaller than this, however, since the food spending elasticity includes increased quality of food in addition to quantity. We do not know how much smaller, however.

We suspect, however, that this is not the only reason why lower time costs lead to increased consumption. A second issue is that self-control issues are likely to be important, as well. The standard model of consumption involves rational individuals who decide how much to consume on the basis of price and income, fully accounting for the future health consequences of their actions. But at least some food consumption is almost certainly not fully rational. People overeat, despite substantial evidence that they want to lose weight. The diet industry has \$40–\$100 billion in annual revenues (Cummings, 2003). Food brings immediate gratification, while health costs of overconsumption occur only in the future. Maintaining a diet can be very difficult. People on diets frequently yo-yo; their weight rises and falls as they start and stop dieting. Survey evidence on the relationship between actual and self-described optimal weights (from the Behavioral Risk Factor Surveillance Survey, 2003) confirms this difficulty. In general, desired weight rises only slightly with actual weight, particularly for obese individuals.

As a result, people with self-control problems may find themselves overconsuming food, particularly when the time costs of food preparation fall. In this situation, lower time costs of food preparation may be a welfare loss.[8] In this section, we present a framework for self-control problems and evaluate the welfare implications of technical change in such a situation.

**A Model of Self-Control Problems**

Consider an individual who discounts all times in the future at a rate higher than the pure time discount rate, but trades off consumption in future states at the time discount rate. Such an individual will always want to begin a diet tomorrow, because the long-term benefits justify the lost utility tomorrow, but not today, because the immediate gratification from food is high. Reductions in the time cost of food preparation may reduce the welfare of this person, by increasing the immediate consumption value of food relative to the long-term health costs.

This model produces the following condition for optimal food consumption:

$$\boxed{\text{Discount Factor}} \times \boxed{\begin{array}{c}\text{Marginal Benefit}\\ \text{of Food}\end{array}} = \boxed{\begin{array}{c}\text{Marginal Time and}\\ \text{Cash Cost of Food.}\end{array}}$$

The marginal benefit of food is discounted because there is a time delay between the time at which people decide they want to consume and the time at which they actually do consume. In standard exponential discounting models, such time delays of one hour or less are far too small to matter. But for hyperbolic individuals, even these short time delays may matter. Technological change that shortens this time delay will make eating much more attractive for hyperbolic discounters. As a result, a hyperbolic discounter will overconsume relative to the consumer's long-run interests. In the past, time delays due to food preparation limited the tendency to overeat. After all, hyperbolic consumers had to wait an hour before satisfying their desires. Today, mass preparation means that individuals can satiate their desires immediately, and as a result, the impatient eat more.

The intuition behind this argument can be illustrated by thinking about a hungry worker and a vending machine filled with cookies. If the vending machine is 10 feet away, a person might eat mid-afternoon cookies, even if the worker is on a diet (the diet can always start tomorrow). The same person, however, might not be willing to walk 10 minutes to and from the store to get cookies or to spend a

[8] Increased food consumption might be a welfare loss for another reason as well—the external costs of individual weight for medical and disability programs. As with smoking, however, we suspect that such external costs are relatively small compared to the internal costs (Gruber and Koszegi, 2001).

half-hour baking cookies (if at home). The benefits of eating cookies that are 10 minutes or one-half hour down the road are too far away. Many behavioral change programs—like those involved with smoking and drinking cessation as well as weight loss—encourage keeping the offending items as far away as possible. Raising time costs is believed to reduce consumption.[9]

In this kind of model, food consumption carries two costs: the value of foregone consumption of nonfood items and the health and social costs of increased weight. In equilibrium, the consumer will choose caloric intake so that the marginal benefit of additional food consumption is equal to the costs of foregone consumption and lower health. Technological innovation that allows mass preparation of food will impact consumption in two ways: first, through a decline in price of food (where price is understood as including preparation and clean-up time), and second, in reducing the delay before consumption. The price reduction will affect all; the reduced time delay is likely particularly to affect people with self-control problems. The essence of self-control problems is that people have difficulty passing up current pleasure for future benefits. Anything that decreases the delay of benefits exacerbates this problem.

This result helps to explain one of the most striking facts about the recent rise in obesity—the dramatic increase at the upper tail of the weight distribution. People with self-control problems are more likely to have high initial weight levels and are more likely to gain more weight with further improvements in food technology. This result also helps to explain why reductions in the time cost of food might have a much larger impact on the level of obesity than reductions in the monetary cost of food. Because reduced time costs affect both the price of the food and the delay before consumption, hyperbolic consumers will be very sensitive to changes in time delay, even if they are not very price sensitive.

**Welfare Implications of Lower Time Costs**

Changes in the time costs of food preparation have two opposing effects on welfare. The direct impact is that reduced time costs lower total prices of food consumption and thus raise consumption. This reduces other consumption and may harm health, but a rational consumer takes these into account. For a rational consumer, when prices fall, welfare increases. A consumer with self-control problems may well spend more than is optimal on food, however. There are two possible welfare costs from this behavior. The first cost is the reduction in consumption of other goods beyond what a rational person would do. We suspect that this term is small; after all, the chief harm from people overconsuming food is not that they are immiserized by additional food spending, but the health costs of increased weight. That health cost of overconsuming is the product of the weight gained and the

[9] This situation can be modeled formally using the hyperbolic discounting framework of Laibson (1997) and Harris and Laibson (2001). We sketch the analysis here and refer readers interested in a formal treatment to our working paper, Cutler, Glaeser and Shapiro (2003). O'Donohue and Rabin (1999) discuss the effects of immediate versus delayed rewards in a hyperbolic discounting model.

health costs of additional weight, weighted by the degree of nonrational discounting. People are worse off if this health cost is greater than the welfare gain from lower costs of food preparation. Thus, people are worse off if

$$\boxed{\begin{array}{c}\text{Difference between}\\ \text{Standard and}\\ \text{Hyperbolic}\\ \text{Discount Rates}\end{array}} \times \boxed{\begin{array}{c}\text{Change}\\ \text{in Weight}\end{array}} \times \boxed{\begin{array}{c}\text{Cost of}\\ \text{Weight}\end{array}} > \boxed{\begin{array}{c}\text{Change in}\\ \text{Costs of Food.}\end{array}}$$

If preferences were rational, the difference between standard and hyperbolic discounting would be zero, and the left-hand side of this equation would be zero. The health effect would be fully internalized, and welfare would necessarily increase. With nonrational discounting, weight may increase too much, and people may be worse off.

To compare these terms, we need to express everything in the same units. It is easiest to evaluate them in units of time. We do not know the monetary willingness to pay for lower weight, but we can use exercise technology to figure out a rough estimate of the time cost. In time units, people are worse off if

$$\boxed{\begin{array}{c}\text{Difference between}\\ \text{Standard and}\\ \text{Hyperbolic}\\ \text{Discount Rates}\end{array}} \times \boxed{\begin{array}{c}\text{Time Costs of Losing}\\ \text{the Weight Gained}\end{array}} > \boxed{\begin{array}{c}\text{Reduction in Time}\\ \text{Costs of Food.}\end{array}}$$

On average in the United States, there has been a reduction in time costs of food preparation of about 20 minutes per person per day from 1965 to 1995. The 10-pound weight gain over a similar period that corresponds to this time reduction represents about 100 calories per day, or about one mile of daily exercise. If it takes 15 minutes to walk or jog a mile, the time cost of the 10-pounds gained is about 15 minutes per day.[10] The typical person must be better off from the reduction in time costs. Of the 20 minutes saved in food preparation, people could spend 15 minutes exercising, lose the weight gained, and still have five minutes left over.

The only way people might be made worse off by the reduced time of food preparation is if they are particularly impatient and as a result would be willing to forgo more than 15 minutes per day to lose 10 pounds in steady state, but cannot seem to do so. A person who always vows to exercise but never starts can be viewed conceptually as someone willing to pay more than 15 minutes per day to lose 10 pounds.

There is likely to be a difference across people: extremely hyperbolic individuals may be hurt by the change in technology, but people without extreme self-control problems will be better off. While there is no evidence on the incidence

[10] Standard economic logic (setting aside hyperbolic discounting) suggests that the people who don't exercise probably value losing weight by less than this 15 minutes a day.

of extreme hyperbolic discounting in the population, we suspect that most people are better off from the technological advances of mass food preparation, even if their weight has increased.

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