WORKING PAPER

The Rise in Obesity Across the Atlantic

An Economic Perspective

GIORGIO BRUNELLO, PIERRE-CARL MICHAUD, ANNA SANZ-DE-GALDEANO

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RAND LABOR AND POPULATION

The Rise in Obesity Across the Atlantic: an Economic Perspective

Giorgio Brunello, Pierre-Carl Michaud and
Anna Sanz-de-Galdeano

Università di Padova, IZA and CESifo; RAND and IZA; Universitat de Girona and IZA

Abstract

We provide comparable evidence on the patterns and trends in obesity across the Atlantic and analyse whether there are economic rationales for public intervention to control obesity. We take into account equity issues as well as efficiency considerations, which are organized around three categories of market failures: productive inefficiencies, lack of information or rationality and health insurance externalities. We also calculate the long term financial consequences of current US and European obesity trends, and conclude with a brief review of current policies to reduce and prevent excessive body weight both in Europe and the US.

Keywords: Obesity; Health care costs; Efficiency; Equity.
JEL Codes: I1; D6.

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1. Motivation

The World Health Organization (WHO) estimates that worldwide, more than 1.6 billion adults are now overweight and, in addition, 400 million are obese. In the United States (U.S.), the prevalence of obesity has more than doubled from 15% in 1971-1975 (Cutler, Glaeser and Shapiro, 2003) to 34% in 2004 (Center for Disease Control). In Europe, obesity rates are generally lower than in the U.S. (Sanz-de-Galdeano, 2007; Andreyeva et al., 2007), but the rising trend in obesity is seen as a serious threat to public health and an important factor driving up health care costs. Data from the U.S. as well as Europe have shown that obesity may have other negative economic consequences including work absenteeism, higher unemployment and disability payments, earlier retirement and lower wages (e.g. Cawley, 2000 and 2004, Brunello and D'Hombres, 2007). In this paper we provide a transatlantic picture of the obesity epidemic and spell out what economists might be able to add to the current policy debate.

We start with an overview of the basic facts, levels and trends in the prevalence of obesity both in the U.S. and Europe. We focus on these regions because we want to use nationally representative micro surveys to study the phenomenon and these are generally not publicly available in other regions (in particular Asia). Next, we review the existing literature on the causes of the obesity epidemic and judge the explanations from a cross-country perspective by exploiting both micro-survey data and time-use data. It turns out that behaviour rather than genes or nature appears to be a better candidate to explain the sudden rise in obesity in the 1980s in the U.S. and the recent European experience. As others have noted before, this result provides a solid basis for the study of the obesity phenomenon from an economist's perspective, since it suggests that, to a certain extent, obesity is a product of choice.

Because behaviour often reacts to incentives, we ask the classical economic question of whether there are economic inefficiencies in the allocation of resources which are caused by the obesity epidemic. We classify such inefficiencies into three domains: productive inefficiencies, inefficiencies related to limited information or irrationality and inefficiencies related to health insurance externalities. We survey the evidence in each domain. However, we go beyond a simple survey of the literature. In light of the gaps identified in the literature, we conduct our own analysis using new data sources or methods, therefore allowing to assess the robustness of previous results, and offer a European perspective to the debate. Finally, since equity concerns related to obesity have also been raised, we survey the literature on the effect of childhood environment on obesity and similarly supplement such analysis with our own evidence from European data sources.

From this analysis, we identify the areas that still need further research but also draw some conclusions that are fairly solid from our review of the literature and our own analyses. Of course, there is a strong case for intervention to reduce obesity from a public health perspective, since its objective is to maximize health and longevity. But economists care about constrained welfare maximization and typically ask whether less obesity leads either to a more efficient allocation of resources or to higher equity. We summarize our main findings in the following four points:

1. Concerning equity, we find evidence that obesity cannot be entirely the result of individual choice, and show that the BMI of individuals from low and high socio-economic status slowly converges over the life-cycle in Europe, while it diverges in the U.S. One possible interpretation of this result is that the European welfare state might mitigate SES differences while these are exacerbated in the U.S.
2. We show that obesity affects productivity and that employers in countries where it is easier to discriminate against the obese appear to pay lower wages to this group. We also argue that the higher product market regulation the wider the gap between privately and socially optimal BMI. However, given the current broad trend in favour of deregulation, we suggest that production inefficiencies are likely to decline in importance in the future as barriers to entry

and other quantitative restraints to firm entry are progressively removed.

3. We do not find that information deficiencies are a major issue, as the majority of individuals are aware of the health consequences of obesity and rarely declare that having limited information makes it hard for them to follow a healthy diet. We show instead that a high proportion of individuals appear to have self-control problems when it comes to weight management, and that time inconsistency is an important problem.
4. We find that the size of the health insurance externality related to obesity is likely to be small, which suggests that a market failure in the form of a behavioural response to the insurance subsidy is unlikely to be relevant in this context.

Aside from equity and efficiency considerations, policymakers should worry about the consequences of obesity for health expenditures. We use a simulation model to calculate the long-term financial consequences of the current obesity trends in the U.S. and also assess how expenditures would increase in Europe if the U.S. trend was to be experienced in the future. While the case for public intervention is not always very solid and more analyses need to be done to identify and quantify the inefficiencies due to the obesity epidemic both in Europe and in the U.S., we conclude this article by identifying some of the areas where intervention might be warranted.

2. Basic Facts on Obesity

2.1. Definitions and Data Sources

According to the World Health Organization (WHO, 2000) obesity can be defined as the health condition in which excess body fat has accumulated to such an extent that health may be adversely affected. The body-mass index (BMI) is the common measure used to provide a clinical classification of weight status for adults. BMI is defined as weight in kilograms divided by the square of height in meters (kg/m2). Adults with a BMI over 30 are classified as obese. The Body Mass Index (BMI), albeit somewhat crude, has been found to be highly correlated with more precise (and more costly to collect) measures of body fat (Revicki and Israel, 1986).[1]

We use a multitude of datasets to document the prevalence of obesity in Europe and the United States. Surveys that focus on the general population tend to have good measures of BMI but relatively poor information on health, particularly so in Europe. We will use the National Health Interview Survey (NHIS) in the U.S. and the European Community Household Panel Survey (ECHP) for the purpose of establishing prevalence and trends in BMI and obesity in the general population. The NHIS collects data each year on a nationally representative cross-section of the American population while ECHP is a longitudinal study collected from 1994 to 2001 with data on BMI for a subset of countries (Denmark, Belgium, Ireland, Italy, Greece, Spain, Portugal, Austria and Finland) from 1998 to 2001.[2] For the adult British population, we use the 2004 wave of the British Household Panel Survey (BHPS). We also make use of aggregate data published by the OECD (OECD Health data, 2006). The OECD uses multiple sources within each countries to construct its figures and provides long time-series for some countries going back to the early 1980s.

We also use other surveys that focus on the elderly, the so-called "ageing studies". These surveys have both the advantage of containing a battery of health variables which are useful in an analysis of obesity, particularly when looking at health care costs, and are based on larger samples of individuals at advanced ages, thereby providing better estimates for this age group. For the U.S., we will use the Health and Retirement Study which follows a number of representative samples from cohorts aged 50+ at baseline. As of 2004, the HRS is representative of the age

[1] It must be acknowledged that self-reported anthropometric variables may contain measurement error with heavier persons more likely to underreport their weight (Palta et al., 1982; Kuczmarski et al., 2001). We take this into account by using regression estimates of true weight and height on self-reported measures stratified by gender and race. We use regression estimates based on U.S. data from Cawley and Burkhauser, 2006). As Michaud et al. (2007) report, this does not tend to affect country rankings in terms of BMI or obesity. Sanz-de-Galdeano (2007) finds that the rank correlation between country level self-reported and objective measures of weight is very high.

50+ population in the U.S. when appropriate survey weights are used (individuals born 1954 and earlier). We will use all cohorts available as of 2004. For Europe, we will use two sources of data. The Survey of Health, Ageing and Retirement in Europe (SHARE) collected in 2004 nationally representative samples of the age 50+ population in 10 European countries.[3] For England, we use the 2nd wave of the English Longitudinal Study of Ageing (ELSA) collected in 2004-2005. HRS, SHARE and ELSA have been designed with comparability in mind such that questions on a large range of topics are generally comparable.

2.2. Obesity Across the Atlantic: Levels and Trends

There are substantial cross-country differences in the prevalence of obesity among adults aged 18-50 as can be seen from Figure 1. First, it is clear that the U.S. stands apart as a country with a high prevalence of obesity. In 2001, 22.38% of women and 21.97% of males aged 18-50 were classified as obese, compared with an average 9.61% and 9.06% respectively in European countries covered by the ECHP data. The U.K. falls somewhat in between other European countries and the U.S.: the prevalence of obesity in 2004 for the U.K. was 16.31% for women and 21.97% for men.[4]

There is no consistent regional pattern in Europe but substantial variation across countries. Some Southern European countries such as Spain and Portugal have high obesity rates while Italy has a much lower prevalence of obesity. In Northern Europe, Denmark and Finland have high obesity rates while Ireland, Belgium and Austria have much lower rates.

An important question is whether there was always a large difference between obesity rates in the U.S., the U.K. and the rest of Europe. For lack of historical data in Europe it is impossible to completely answer the question (only

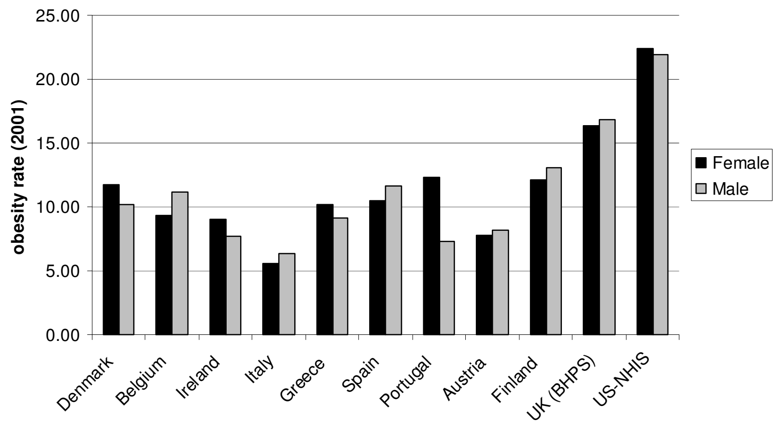
[2] We have attempted to see if estimates based on longitudinal data were different from those in cross-sectional datasets due to attrition, etc. This is not possible to do in Europe. For the U.S., we have compared the prevalence of obesity in the NHIS with the prevalence from a longitudinal study, the Panel Study of Income Dynamics (PSID). In 2001, the difference in the prevalence of obesity was negligible.

[3] We do not include Switzerland in the analysis because the response rate was low therefore raising concers that the sample is not representative of the population. Data from Belgium was also not available in the dataset used. Hence, we consider 8 countries from SHARE.

[4] Data are not available for the U.K. in the 2001 wave of the BHPS. We use data from 2004 instead.

two countries, Finland and the Netherlands have historical data going back to the early 80s).

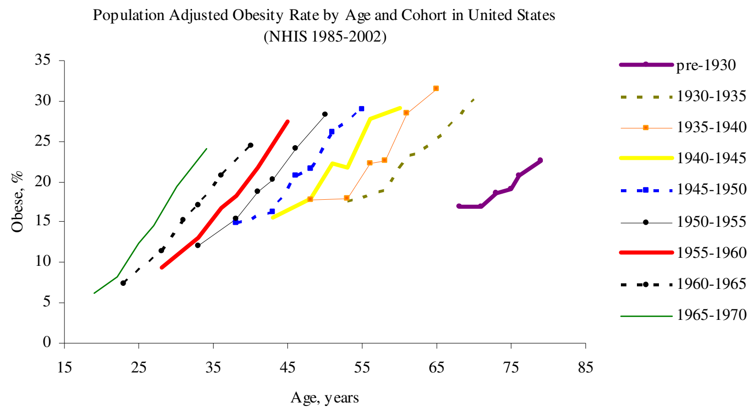
Figure 1 Prevalence of Obesity among Adults (aged 18-50)



From OECD data, the trend in obesity during the 1980s for the Netherlands and Finland was negligible. In both countries, 1990 obesity was 1 percentage point (p.p.) higher than in 1980. Obesity increased during the 1990s for these two countries (2.8 p.p. in Finland and 3.3 in the Netherlands). France witnessed a similar increase. On the other hand, obesity increased by 7 p.p. in the U.K. and 8.5 p.p. in the U.S. during the 1990s. Therefore, although it is possible that obesity rates were already different across the Atlantic in the early 1980s, the gap has most probably widened since then.

We can also view the same phenomenon as a function of age, cohort and time effects. We first plot in Figure 2 the fraction of obese individuals (BMI>30) at a given age for people born in different cohorts in the U.S. from 1985 to 2002 using NHIS data. The pattern is striking: important cohort differences exist in the U.S. which suggests that time effects operated mostly during the 1980s and 1990s. For example, at age 60, Americans born between 1930 and 1935 had an obesity rate of 23% compared to 29.1% for those born between 1940 and 1945.

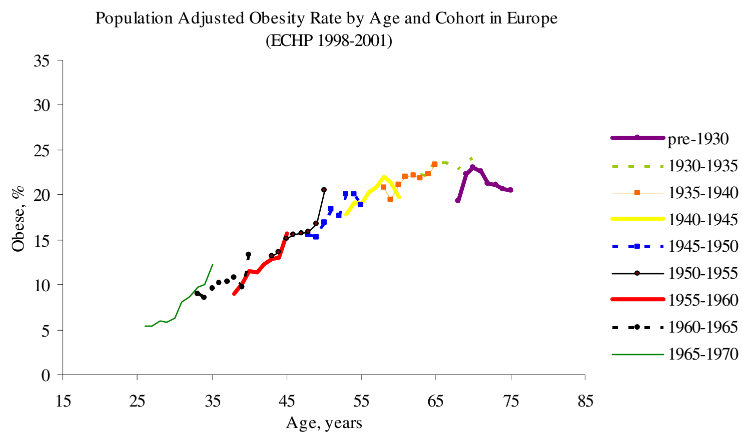
Figure 2



Source: Own calculations from NHIS (1985-2002). Correction for measurement error applied.

If the same forces were operating in Europe during the 1980s and 1990s, cohorts born in different years in the ECHP would likely have accumulated different BMI as of 1998 when we first observe them. Figure 3 shows the cohort-age profile (which excludes the U.K.). In European countries covered by the ECHP, cohorts tend to follow a similar life-cycle pattern with obesity rates increasing with age. There is little evidence that each cohort diverges from the preceding ones except perhaps for younger ones (those born after 1960). Hence, the trend in obesity is likely to be more recent in Europe than it is in the U.S. and the U.K., which followed the same growth path as the U.S. in the 1990s.

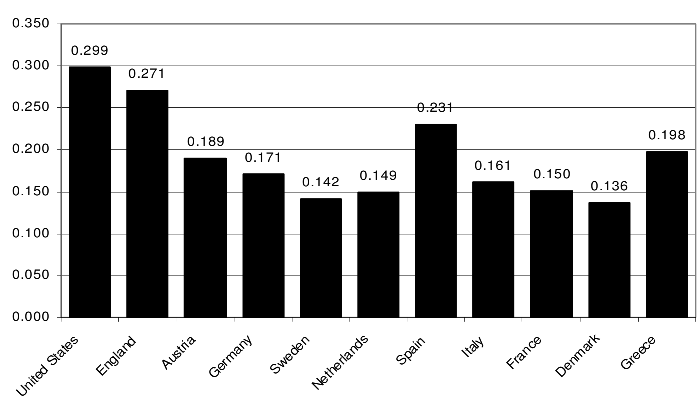
Figure 3



Source: ECHP 1998-2001 (pooled Finland, Autria, Portugal, Spain, Greece, Italy, Ireland, Belgium and Denmark..Sample weights used.

The next figure (Figure 4) shows the estimates of the percentage of obese individuals in the age 50+ population using the available ageing surveys (HRS for U.S., SHARE for Continental Europe and ELSA for England). A cross-country pattern similar to that in Figure 1 emerges: older Europeans tend to be lighter than their American counterparts. The only exceptions are England and Spain where obesity is relatively high.

Figure 4 Fraction Obese, Age 50+ Population in 2004-2005



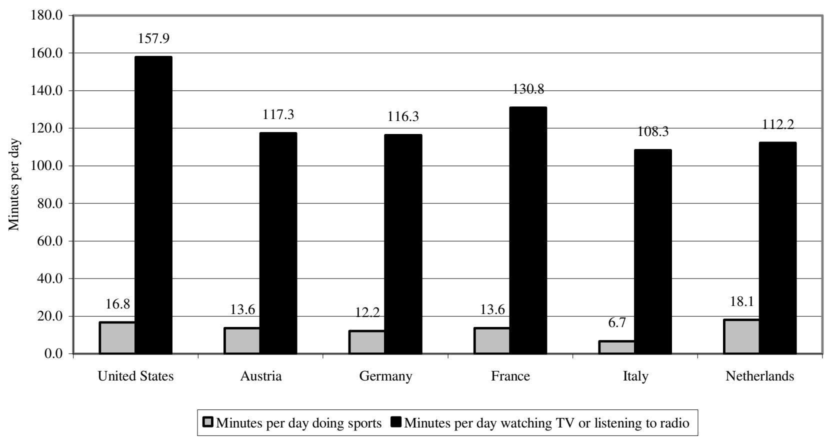
Source: Own calculations from HRS 2004, SHARE 2004 and ELSA wave 2 (2004-2005).

2.3 Explanations for the Rise in Obesity and Cross-Country Variation

Two important questions are raised by the stylized facts in Section 2.2: 1) why do we observe such stark differences across countries in the prevalence of obesity? 2) why has obesity risen so much in the U.S. and the U.K. while it appears to have remained relatively steady in the rest Europe during the 1980s and early 1990s? A good place to start to answer both questions is the following observation: weight increases when systematically more calories are consumed than burned. Short-term fluctuations in calorie intake or expenditure are likely to be washed away by an individual's metabolism, which is elastic up to a certain level of daily variation. However, when the excess calorie gain is more permanent, calorie imbalance materializes in weight gain. Hence, one has to either find reasons why calorie expenditure has gone down over the years or calorie intake has gone up, and importantly why this happened in the U.S. and the U.K. but not in the rest of Europe.

On the expenditure side, Cutler et al. (2003) make the point that while calories consumed have risen markedly in the U.S., the amount of physical activity has not gone down but rather slightly up. Figure 5 shows the cross-country variation from the Multi National Time Use Survey (MTUS), an harmonized collection of time use studies for some of the countries covered by our analysis, in the time spent per day doing sports and watching television or listening to the radio. Clearly, even though Americans are more obese than Italians, they are spending more time doing sports. The story is somewhat different for sedentary activities such as watching TV. Americans spend on average 2.5 hrs per day doing such activity compared to less than 1.5 hrs in Italy. So substitution is likely to have occurred with other activities and the question is whether the substitution has come from less or more energy intensive activities. From 1965 to 1995, Cutler et al. (2003) report that time spent watching TV has increased by 40 minutes per day in the U.S., largely taking up time spent doing household work, which includes food preparation (going from 146 minutes per day to 102). So the increase in time spent doing sedentary activities has occurred at the expense of home production, which includes food preparation and consumption[5]. Such activities are likely to involve a limited amount of physical work. Overall, this suggests that differences in calorie expenditures cannot explain the difference in obesity between the U.S. and Europe (excluding the U.K.).

Figure 5 Time Spent per Day Doing Physical and Non-Physical Activities



Source: Own calculations from harmonized MTUS sample of aged 20+ respondents. France MTUS sample from 1998, Netherlands 1995, USA pooled 1992-94-98, Italy 1989, Germany 1992, Austria pooled 1992-1997

The substitution away from home production can be seen using data from the MTUS. In Table 1, we show that Americans spend an average of 34 minutes per day preparing meals at home compared to 86.1 minutes in Italy. Furthermore, they spend less time consuming meals at home. Time spent eating at home is also much lower (55.8 minutes) than in Western Europe (ranging from 71 to 103 minutes per day).

[5] Most time-use surveys ask respondents to fill in a diary where they report primary activities. A caveat is that we cannot account for differences in joint activities (working out on a stationary bicycle while watching TV or eating while watching TV).

Table 1 Time-Use Patterns and Calorie Intake Across Countries

		Minutes spent per day			
country	Total Calorie intake per capita	eating on restaurants	eating meals at home	time cooking at home	calorie per minute eating
United States	3774	14.4	55.8	34.1	53.8
Austria	3673	5.7	83.2	63.8	41.3
Germany	3496	5.5	78.4	61.1	41.7
France	3654	25.6	103.3	57.5	28.4
Italy	3671	12.4	101.4	86.1	32.2
Netherlands	3362	4.6	70.9	57.4	44.5
Total	3605	11.1	87.8	66.3	36.5

Notes: Own calculations from harmonized MTUS sample of aged 20+ respondents. Calorie data comes from OECD Health Data 2005 and refers to the year 2002. France MTUS sample from 1998, Netherlands 1995, USA pooled 1992-94-98, Italy 1989, Germany 1992, Austria pooled 1992-1997 samples. Weighted using individual level weights.

Americans also consume more per day than any other country. The total amount of calorie per capita consumed daily is larger in the U.S. (3774) than in any other country (ranging from 3300 in the Netherlands to 3673 in Austria). Hence, cross country differences in obesity rates are more likely to be explained by food intake rather than caloric expenditure. But why do Americans consume more? Cutler et al. (2003) argue that this is due to the decrease in the time cost of food preparation and that this change has not happened elsewhere than in the U.S. The time cost has several origins: food price, wages, food preparation technology. The variation over time and space in food prices is limited so that it is not clear that this played a large role. Also, the opportunity cost of time is likely to have gone up rather than down over time as wages have gone up for men and employment possibilities have increased for women.

Technology might be the source of differences. If we divide calorie per day by the amount of time in minutes preparing food, we find that Americans consume 42% more calories per minute than Europeans. Hence, this points to important differences in the way calories are consumed and perhaps the type of food which is consumed. Reviewing the legal environment in Europe, Cutler et al. (2003) show that high number of food statutes and the slow penetration of mass preparation technologies, which encourage rapid consumption of food, might explain the U.S.-

Europe difference.[6] Although research based on U.S. variation tends to find a role for food prices and the quality of food supplied (Chou, Grossman and Saffer, 2004), little international evidence exists on the extent to which food prices, the penetration of technology and regulation are related to the prevalence of obesity. This is likely to be an important research area in the future as better international data is collected.

Other explanations have been proposed. Due to the increase in income per capita obesity could have increased, simply because food is a normal good. Yet, this is incompatible with the fact that obesity has been shown to be negatively related to income at the micro level. Furthermore, obesity has increased at a similar rate among all education groups in the U.S., which is inconsistent with the very different wage growth these groups have experienced during the 1980s and 1990s. Philipson and Posner (1999) argue that energy spent on the job has gone down as occupations have become more sedentary. But this long-term trend had started a long time before obesity started to rise and was similar across countries.

The rapid growth of obesity in the U.S. relative to Europe over the last 2 decades also allows to dismiss genes or nature as an important factor in determining obesity. Although genetics probably play some role, the gene pool of the U.S. population is likely not to have changed dramatically over the last 30 years and even less relative to that in Europe. So there has to be a behavioral component to the rise of obesity witnessed in the U.S., whether due to a reaction to the decrease in the time-cost of food preparation and consumption or some other unmeasured factor leading to lower calorie expenditure. This is an important reason why obesity is not only a public health issue but also an economic problem.

3. Is Public Intervention Justified? Efficiency and Equity Issues

From an economic perspective, public intervention is justified either on efficiency or on equity grounds[7]. Consider first efficiency. As argued by Cawley

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[6] In 2001, nearly 85% of households had a microwave oven in the U.S. compared to 48.9% in France and 57.3% in the Netherlands (European figures from Eurostat *Consumers in Europe: Facts and Figure* while U.S. figure reported in Cutler et al.

[7] Cawley, 2004, argues that the main economic concern should be efficiency, and that equity considerations should be left to policy makers.

(2004), if individuals were perfectly rational and their decisions about food and weight imposed no costs on others in society, if information about the consequences of obesity were accurate and readily available and if markets were perfectly competitive, there would be no market failure and no reason for government intervention. When one or more of these assumptions are violated, market failures occur and the socially optimal level of obesity can differ from that chosen by individuals operating in free markets.

Market failures have been identified and discussed in the literature on obesity in the following three areas: limited information, externalities and lack of rationality. Information about the calorie content of purchased food may be insufficient – or costly to use. Externalities associated to obesity are likely to occur when health and life insurance premiums fail to consider that obese individuals tend to be sicker and have higher healthcare expenditures. This happens when premiums do not reflect weight. In this case, some of the costs are borne by others or by society at large (see Bhattacharya and Sood 2005). Lack of rationality occurs, for instance, when individuals have time inconsistent preferences and lack of control problems (Cawley 2004).

Less attention has been paid to the market failures originated by the fact that product and labour markets are often regulated and can deviate systematically from perfect competition. In this case, private and socially optimal outcomes can differ if obesity affects productivity and/or if the wages earned by the obese differ from those received by equally productive non/obese individuals. In this section, we review these different sources of inefficiency and complement the existing evidence – mainly from the US – with additional evidence from Europe.

3.1 Product and Labour Market Imperfections

Evidence that product markets deviate from perfect competition is abundant. In a recent study of price mark-ups and product market regulation, the OECD finds that price-cost margins are close to 10 percent in manufacturing and to 20 percent in non-manufacturing industries (see Hoj et al., 2007). The US ranks low in the latter but is about average in the former. On the other hand, some European countries (the UK and Sweden) have below average mark-ups and some continental European countries (Italy and Austria) having higher than average values.

There is also abundant literature documenting that wages and marginal products can differ systematically (see for instance Frank, 1984). This can occur because information is less than perfect and the match of workers and firms is characterized by the presence of frictions, or because firms offer contracts which provide insurance to their risk averse workers. Alternatively, there may be firm – specific assets such as training and hiring and firing costs which generate rents and support bilateral bargaining (see Lindbeck and Snower, 1988, Malcomson, 1997). Finally, and especially in Europe, labour market institutions such as employment protection and labour unions can promote rent sharing between firms producing in imperfectly competitive markets and their employees.

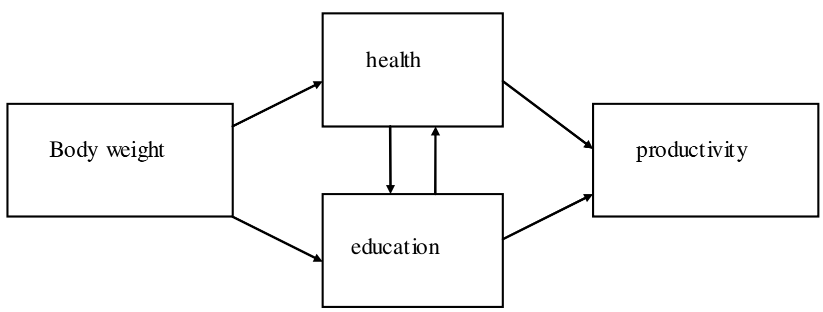
In the Appendix we illustrate the implications of imperfectly competitive product and labour markets for body weight using a stylized model where workers – consumers supply labour in-elastically to firms operating in imperfectly competitive product markets. The model – which draws from Blanchard and Giavazzi, 2003 – has two key ingredients: first, firms face positive entry costs; second, the presence of product market rents and the imperfections of the labour market imply that wages are bargained between workers and firms. We show that these imperfections are a necessary but not sufficient condition for the average body weight which maximizes social welfare to differ from the private optimum. Additional conditions are that either body weight affects productivity or that it affects earnings conditional on productivity. In the next two sub-sections we examine these conditions in some detail.

3.1.1 Body Weight and Productivity

Are the obese less productive than the non-obese? Given the paucity of individual data on productivity, it is useful to frame the discussion of this question within the "health augmented" Solow model of productivity growth[8]. As illustrated in Box 1, according to this model the steady state level of output per head is a function of total factor productivity, the investment rate and the stock of human capital. Human capital has two dimensions, education and health. Better health increases productivity both directly and indirectly. The former effect occurs because life expectancy raises and disability falls. The latter effect takes place because better health – by lengthening the planning horizon - raises the incentives to invest in education, which affects productivity level and growth.

As illustrated in Figure 6, body weight and obesity can affect productivity if they influence health conditions and the incentives to invest in further education. In the rest of this sub-section, we shall review the existing empirical evidence and add our own on the relationship between the key blocks of the figure, starting from human capital and productivity.

Figure 6 The relationship between body weight and productivity



3.1.1.1 Education, health and productivity

Strauss and Thomas, 1998, review the existing microeconomic literature and conclude that evidence exists in favour of a causal impact of health on productivity in low – income countries, where manual work is still important. Bloom, Canning and Sevilla, 2004, review the literature which includes health, in

[8] Imperfect product and labour markets imply that we cannot use wages as a proxy of productivity.

the form of life expectancy, in cross country growth regressions. Their own evidence is that each extra year of life expectancy raises the productivity of workers by 4 percent. These estimates, however, have been criticized by Weil, 2006, because they fail to deal in a satisfactory way with the endogeneity of health[9]. He uses calibration rather than estimation and finds that a one percentage point increase in the adult survival rate increases productivity by 1.68 percent. Acemoglu and Johnson, 2006, instead, use an instrumental variable technique and find no evidence that the large changes in life expectancy experienced during the second part of the last century led to a significant increase in output per head.

BOX 1 The health augmented Solow model

In the standard Solow model, steady state log output is given by

$$y = \gamma_0 a + \gamma_1 h + \gamma_2 s \quad \text{(B1)}$$

where y is log output per head, a is total factor productivity, h is log human capital and s is log investment rate. Following Acemoglu and Johnson, 2006, the stock of health X affects both total factor productivity and human capital

$$A = A_o X^{\beta} \quad \text{(B2)}$$

$$H = H_o X^{\eta} \quad \text{(B3)}$$

and log output per head can be written as

$$y = \gamma_0 a_0 + \gamma_1 h_0 + \gamma_2 s + \gamma_3 x \quad \text{(B4)}$$

Following Bloom and Canning, 2005, let total factor productivity vary over time as follows

$$\Delta a = \lambda(a^* - a_{-1}) \quad \text{(B5)}$$

where a^* is a country specific threshold. Taking first differences of steady state output and rearranging yields

$$\Delta y = \mu_0 - \mu_1 y_{-1} + \mu_2 h_{-1} + \mu_3 s_{-1} + \mu_4 x_{-1} + \nu_1 \Delta h + \nu_2 \Delta x + \nu_3 \Delta s + \varepsilon \quad \text{(B6)}$$

This dynamic error correction model has been estimated using US data by Bloom and Canning and Sevilla, 2004, who measure health with life expectancy at birth.

[9] Bloom et al., 2004, use lagged measures of health to instrument current health.

Conditional on life expectancy, average output per head can fall if individuals in poor health or disabled retire earlier from the labour market or spend more time in unemployment and out of the labour force. Lumsdaine and Mitchell, 1999, review the empirical studies investigating the relationship between health and retirement. Over the last 10 years, a number of studies have shown that poor health is clearly one the determinant of retirement behaviour. However, it is unclear how sizeable the effects are. Bound, Schoenbaum, Stinebrickner and Waidmann (1999) report that not only poor contemporaneous health but also the decline in health are important determinants of retirement behaviour, encouraging early retirement.

French (2005) reports that, even with an admittedly crude measure of health, poor health can explain about 10% of the drop in the labour force participation rate between the ages of 55 and 70. Using a richer set of health measures, and correcting for the endogeneity of health, Bound, Stinebrickner and Waidmann (2007) show that health has a sizeable impact on retirement insurance in the U.S. For example, they report exit rates at age 62 that are 5 times as high for those in poor health relative to those with average health. The relationship with application for disability insurance is relatively unambiguous: poor health increases the risk of early exit through disability insurance and this tends to be robust across countries (Benitez-Silva et al., 1999; Kerkhofs et al., 1999; Bound et al., 1999)

In comparison, the relationship between health and labour force participation and hours worked at earlier ages has been studied for a longer period. However, Currie and Madrian, 1999, review the US empirical literature and conclude that little consensus has been reached on the magnitude of the associated effects, although researchers have consistently found some effects of health on labour market outcomes. Such effects tend to vary with the measures of health used (tend to be larger for measures of disability and mental health problems) and most studies narrowly focus on particular demographic groups (white males).

There is a vast literature investigating the effects of education and years of schooling on output per head and productivity growth. In a recent review of this literature, Sianesi and Van Reenen, 2003, argue that the evidence in support of the fact that education increases productivity is compelling, and conclude that one additional year of education is expected to raise productivity by 3 to 6 percent. In a similar fashion, Arnold, Bassanini and Scarpetta, 2007, estimate a multi-country growth model on OECD data and find that one additional year of education raises output per capita by 6 to 9 percent.

The relationship between education and health is also widely studied. Cutler and Lleras Muney, 2007, for instance, estimate the education gradient for several health outcomes, including obesity, and find evidence that education generally matters even after controlling for income and demographic controls. The potential effects of higher life expectancy on human capital accumulation is less widely investigated, and the main point here is that people who live longer have greater incentives to invest in human capital (Soares, 2005). The relationship between health outcomes and education is important in the light of the controversial evidence on the size of the effects of health on productivity, because it suggests that health can matter for output per head also because it raises years of schooling.

3.1.1.2 BMI, Education and Health

Does obesity affect education? Datar and Sturm, 2006, investigate data on US children and find that being overweight is a significant risk factor for girls but not for boys. Kaestner and Grossmann, 2008, examine children ages 5 to 12 in the US NLSY and find that children who are overweight or obese have achievement test scores that are about the same as children with average weight. They also review evidence on the educational achievement of adolescents, and conclude that obesity in this group is associated with lower attainment. Ding et al, 2006, use genetic markers to instrument health and find that the academic performance of female US adolescents is negatively affected by poor physical and mental health outcomes, including obesity.

Another study in this area is Gortmaker et al, 1993, who use the 1979 NLSY and show that girls aged 16 to 23 who where overweight had 0.3 years less education than normal weight girls eight years later. We perform a similar exercise for 9 European countries, using the data from the European Community Household

Panel, a longitudinal dataset covering the period 1994-2001[10]. We select the cohort of students aged 16 to 23 in 1999 and measure educational attainment both in that year and in the final available year, 2001, and define an dummy variable that is equal to 1 if the observed change in the number of years of schooling is positive and 0 otherwise. In line with Kaestner and Grossmann, 2008, we model the probability that educational attainment increases as a function of age, age squared, parental education and BMI.[11]

While we cannot exclude that omitted factors which affect changes in school attainment are correlated with BMI, we try to attenuate reverse causality by using not the current BMI but the first available measure in our data, the body mass index in 1998, one year before our first observation of educational attainment. Probit results are shown in Table 2, which consists of three columns, one for the full sample and the remaining two for males and females.

We find that European adolescents with a higher body mass index complete fewer additional years of schooling in the window of time allowed by the data. This is especially the case of female adolescents, as shown in the last column of the table. Our estimates in the first column of the table suggest that a 10 percent increase in BMI would reduce the probability of adding at least one year of school in the two – years window by 6.28 percent when evaluated at the mean (-.005*22.51/.179). This effect is larger for females than for males. Overall, the evidence suggests that overweight adolescents are likely to attain lower education than normal weight children and adolescents. Two reasons for this are that obese students are exposed to stigma and psychological pressure, and have a higher number of sick days (Datar and Sturm, 2006)[12].

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[10] These countries with data on BMI are: Austria, Denmark, Ireland, Italy, Greece, Spain, Portugal, Finland and Belgium.

[11] In order to measure parental education we use the highest educational attainment among parents. We have also experimented with a measure of smoking, but with little success.

[12] Compared to us, Datar and Sturm find a statistically significant relationship for females but not for males.

Table 2 The Effect of BMI on Changes in Educational Attainment. Marginal Effects

	All	Males	Females
Bmi	-0,005	-0,0003	-0,01
	[1.83]*	[0.09]	[2.43]***
Age	-0,006	-0,004	-0,009
	[1.36]	[0.67]	[1.44]
Low Parental Education	-0,019	0,003	-0,039
	[1.10]	[0.13]	[1.57]
Observations	2193	1134	1059

Notes: each regression includes country dummies and a constant term. A gender dummy is included in the first column. T - statistics based on robust standard errors within brackets. One, two and three stars for statistical significance at the 10, 5 and 1% level of confidence.

Finally, consider the relationship between obesity and health. Numerous studies have found that obesity increases the risk of type 2 diabetes (Colditz et al, 1995: a two-fold increase in risk for 10kg gained after age 18), coronary heart disease (Willett et al, 1995: two-fold increase for women with BMI of 28.9 compared to 25), hypertension (Brown et al, 2000: 15% for BMI<25, 42% for BMI>30), stroke, gallbladder disease, osteoarthritis, respiratory disorders and some type of cancer (National Institute of Health, 1998, and Michaud et al, 2001). Hence, the epidemiological literature is quite unambiguous on the effect of obesity on health, conditional on survival. What about life-expectancy? Since obesity is a predictor of all diseases mentioned and these are linked to mortality, one would infer that obesity reduces life-expectancy. However, there is much debate in the literature on this issue since obesity, unlike smoking, might have a protective effect in old-age (Stevens et al., 1998; Calle et al., 1999; Visscher et al., 2000; Grabowski and Ellis, 2001). There might be important endogeneity issues at the micro level that might confound the relationship between obesity and mortality. Hence, we test whether such a negative relationship can be observed at the macro level.

We integrate the cross country data on average life expectancy at birth and public health expenditure in the OECD Health Database with data on the percentage of obese individuals in the population, which we collect partly from the OECD and partly from the ECHP. US data are drawn from the BRFSS (Behavioural Risk

Factor Surveillance System). We end up with an unbalanced panel of 12 developed countries covering the period 1979 to 2004[13], which we use to estimate the following error correction specification[14]

$$\Delta \ln LE_{it} = \gamma_C + \alpha \ln LE_{it-1} + \beta \ln GDP_{i,t-1} + \delta \ln H_{i,t-1} + \phi \ln OB_{i,t-1} + \lambda \ln TOB_{it-1} + \mu \ln EXP_{it-1} + \psi t + \xi t^2 + \theta_{it} \quad [2]$$

where LE is life expectancy, OB the share of obese individuals, GDP is GDP per head, H the number of years of schooling, EXP health expenditure and TOB the percentage of daily smokers. Table 3 presents our results.

Table 3 Estimated effects of obesity on life expectancy at birth. Dependent variable: change in log life expectancy

	1	2
log lagged life expectancy	-0.241	-0.295
	[2.77]***	[2.91]***
log lagged GDP per head	-0.01	-0.01
	[2.80]***	[1.99]*
log lagged schooling	0.023	0.02
	[2.76]**	[2.18]*
log lagged obesity rate		-0.008
		[4.57]***
log lagged health exp/GDP		0.0007
		[0.19]
log lagged tobacco consumption		-0.004
		[1.51]
Observations	155	155
R Squared	0.25	0.25

Notes: see Table 2. Each regression includes country dummies, a linear and a quadratic trend.

The parsimonious specification in column (1) shows that life expectancy is negatively correlated with GDP per head but increases with schooling. The negative correlation between GDP growth and longevity has already been noticed in this literature (see Lichtenberg 2002 and Cutler, Deaton and Muney, 2006). In column

[13] A few missing data in the sample are generated by linear ipolation.

[14] Lichtenberg, 2002, models life expectancy as a function of the "health expenditure stock". If such relationship is linear, it can be written in autoregressive form. We deviate from Lichtenberg by assuming that expectancy depends on the lagged rather than on the current stock and by adding additional explanatory factors such as the lagged obesity rate. Lags are introduced here to alleviate the problems associated to the potential endogeneity of regressors.

(2) we add the log of lagged obesity rate to the regression, log lagged health expenditure on GDP and log lagged tobacco consumption, and find evidence of a statistically significant negative correlation between longevity and obesity, indicating that a 10 percent increase in obesity rates reduces life expectancy by 0.29 percent. To illustrate, the obesity rate in the USA in 2004 was 23.43% in our data. If we were to bring this rate back to its 1994 value – 14.36 percent – life expectancy would increase by 1.126 percent, slightly less than a year from the baseline of 77.5.

3.1.2 Body Weight and Earnings

At least since the work by Hamermesh and Biddle, 1994, the study of labour market discrimination has been extended from race and gender to other groups of the population, including the ugly and the obese. Identifying discrimination is a daunting task, because it requires that we compare individuals with identical characteristics and show that they are treated differently because of some observable characteristic – including obesity. The more modest tasks of this sub-section are: a) to briefly review the large empirical evidence on the relationship between obesity and wages; b) to discuss Becker's insight that discrimination is reduced by market competition using both cross country data on the wage penalty or premium associated to weight and measures of product market regulation.

The empirical literature which studies the impact of BMI on wages is vast, and we cannot pretend to fully review it here. Rather, we present a selected summary of the findings in Table 4, which includes a few representative studies for the US and Europe. Some of these estimates are based on ordinary least squares, and thereby fail to recognize the endogeneity of the body weight in wage regressions. Other research uses an IV strategy, sometimes in combination with fixed effects (see Cawley, 2004b, and Garcia and Quintana-Domeque, 2006, for a good discussion of the econometric issues). Overall, while the majority of studies find evidence of a negative relationship between BMI and earnings, especially for females, these estimates are rarely statistically significant at the standard levels of confidence. Moreover, few if any of these studies try to decompose the uncovered effects into the component associated to differences in productivity and discrimination effects.

Table 4 Estimated effects of BMI on (log) wages. Selected empirical research

Authors	*Data*	*Method*	*Impact of BMI or obesity on log wages*
Cawley, 2004	NLSY, USA	IV – BMI of biological family member	BMI on wages: -0.013 white males, -0.017** white females
Norton and Han, 2007	NLSAH, USA	IV- genetic information	BMI on wages: -.023 males, -.018 females
Behrman and Rosenzweig 2001	Minnesota Twins	Within twins IV	BMI on wages: .0019 females
Sargent and Blanchflower, 1994	NCDS, UK	OLS	Obesity on wages: 0.009 males, -0.074*** females
Greve, 2005	Danish administrative data, Denmark	OLS	BMI impact on wages: -0.0003 males; -0.002 females
Johansson et al, 2007	Health 2002, Finland	OLS	BMI impact on wages: 0.003 males; -0.001 females
Lundborg et al, 2005	SHARE Europe	IV – birth order	Obesity on wages: -0.86 males, -0.12 females
Brunello and D'Hombres, 2007	ECHP Europe	IV – BMI of biological family member	BMI on wages: -0.013*** males, -0.008** females

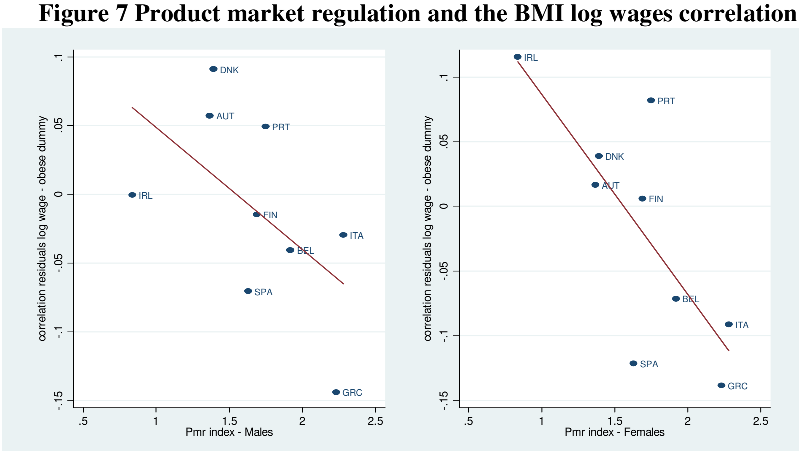
Notes: *, **, *** for coefficients statistically significant at the 10, 5 and 1 percent level of confidence.

An alternative and more indirect route to investigating discrimination effects is to consider its relationship with competition. If some employers have a taste for discrimination against the obese, they will hire fewer workers of this type compared to non discriminating employers. Indulging in their tastes, the former will employ more expensive non obese workers and forego some profits compared to the latter, who hire both types. With freedom of entry, non-discriminators will push discriminators out of the market in the long run and wage equalization between worker types will take place (see Weichselbaumer and Winter-Ebmer, 2007). It follows that, if preferences for discrimination are invariant across countries, its relative importance will be higher in those countries where freedom of entry is more limited and product market competition is more regulated.

To verify this, we use data drawn from the ECHP to compute for each of the 9 countries in the sample the correlation between log earnings and obesity rates, after partialling out a wide range of individual effects which capture differences in productivity[15]. We then regress these correlations on the OECD index of product market regulation, which measures for the year 1998 the relative importance of barriers to entry and others limits to competition (see Hoj et al, 2007). Under the assumption that the bias in the correlation between obesity and earnings is invariant across countries, this exercise is informative on the relative patterns of discriminatory effects.

Figure 7 **Error! Reference source not found.**presents our results separately for males and females. We notice first that the estimated correlation between log earnings and obesity is positive in some countries and negative in others, with a range between -0.15 and 0.10. Second, when we regress these correlations on the index of product market regulation, which increases the tighter are the limits to competition, we find evidence of a negative relationship, especially for females and in line with the prediction of Becker's model. In particular, the negative penalty on obesity is largest among the countries of Southern Europe, with the exception of Portugal.

Figure 7 Product market regulation and the BMI log wages correlation



Sources: OECD and ECHP

[15] Our controls include age, age squared, marital status, education, household composition, industry, country and occupational dummies, dummies for quality of health, dummies for the type of job (part time, temporary, subordinate), dummies for the public sector and the size of the firm, and a dummy equal to 1 if the individual has received training during the past 12 months. We pool data and regress log earnings on these controls and take the residuals. Next, we estimate a probit model where the dependent variable is a dummy equal to 1 for obese individuals and to zero otherwise, using the same list of controls. Again, we take residuals from a linear projection. Finally we compute the country by country correlation and regress this country specific information on the index of product market regulation.

3.1.3 Summary of Productive Inefficiencies

Obesity can influence productivity if it affects health and education. Both have effects on output per head although the latter channel is better understood and has a significant impact on output per head. The current status of empirical research suggests that the strength of the link between education and productivity is less controversial than that operating via health, measured by life expectancy at birth or other health outcomes on early retirement and labour force participation. We have presented evidence for Europe that confirms previous evidence from the U.S. that overweight and obese adolescents tend to complete fewer years of education. Since learning begets learning, this education gap is likely to widen during adult life, with important effects on productivity.

There is also evidence that obesity and high BMI affects individual health by influencing life expectancy at birth. Moreover, health can deteriorate because of obesity even if life expectancy is unchanged simply because individuals spend more time in disability or early retirement. While the strength of the relationship between education and productivity is well-known, some controversy exists on the strength of the relationship between productivity and health. Finally, we have presented cross-country evidence that the relationship between BMI and wages is negatively correlated to the index of product market regulation. This evidence suggests that wage discrimination because of obesity is likely to be a more serious issue for females in the South of Europe.

Overall, this evidence broadly supports the view that, when labour and product markets are imperfectly competitive, the privately optimal level of obesity can differ from the socially optimal level because obesity affects productivity and the wage of the obese conditional on measured productivity are penalized by discrimination. The direction that policy should take, however, remains unclear, and depends on the relative importance of the productivity and discrimination effects. We conclude that additional evidence in this area is needed before reaching firmer conclusions.

3.2 Other sources of inefficiency

Lack of information and limited rationality are sources of market failures that have been acknowledged in the obesity literature (Cutler, Glaeser and Shapiro, 2003, Cawley, 2004). However, to the best of our knowledge, there is no systematic evidence on the empirical relevance of such phenomena for obesity.

3.2.1 Lack of information

There are at least three information issues that may be relevant to body weight. First, individuals may not be accurately informed about the health consequences of being overweight or obese. According to a recent Eurobarometer survey[16], the percentage of women and men who are aware that being overweight is bad for their health is at least 70% in most European countries (Table 5).

Table 5 Percent of European Adults who Think that Being Overweight is Bad for their Health

	Women	Men
Germany	85.70	85.96
Denmark	93.09	91.87
Netherlands	85.47	86.16
Belgium	84.69	84.24
Luxembourg	90.38	84.95
France	83.84	80.53
UK	76.06	73.27
Ireland	72.23	69.72
Italy	57.36	63.24
Greece	90.58	87.82
Spain	70.66	67.93
Portugal	71.70	74.05
Austria	70.02	62.58
Finland	66.33	61.72
Sweden	95.34	94.16
All	78.94	78.61

Note: Statistics based on Eurobarometer Survey No. 64.3, 2005.

[16] The Eurobarometer is conducted on behalf of the European Commission in order to monitor the public opinion in the European Union. For detailed information on the Standard and Special Eurobarometer Surveys, see http://www.gesis.org/en/data%5Fservice/eurobarometer/index.htm.

Comparing across countries suggests that lack of information alone cannot account for the existing difference in obesity rates.[17] For example, the percentage of adults who recognize that being overweight has adverse health consequences is below average both in Finland and in Italy, in spite of the fact that Finland's obesity rate is much higher than in Italy.

As one would expect, the percentage of informed individuals is related to education, both at the macro and at the micro level. At the macro level, countries and groups with a higher percentage of individuals who think that being overweight is bad for their health are generally also those with a higher average level of education. The Spearman rank correlation between these variables is positive, high (0.45) and statistically significant at the 5% level. At the micro level, we have run probit regressions - separately by gender - of the probability of knowing that being overweight has adverse health consequences on age, education indicators and country dummies.[18] The results of these estimates, not reported here for the sake of brevity, confirm the aggregate correlation in that the likelihood of being aware that overweight is bad for one's health is significantly increased by 4 percentage points for women and by 3.7 points for men who have more than 12 years of schooling with respect to their counterparts with less than 12 years of schooling.

Notice that, even if most individuals were fully aware that overweight and obesity are hazardous to health, there may still be information deficiencies if they underestimate the risks or fail to consider the cumulative risks associated with gaining weight. In other words, while gaining weight is easy, losing it is harder[19], and individuals may not be fully aware of the long-term consequences of current weight gains. This is an aspect of the question that has been addressed in the smoking literature: for instance, Slovic, 2000, finds that a high percentage of adolescent smokers deny the short-term risks of smoking and see no health risk from smoking the "very next cigarette", failing to appreciate the addictive

[17] For the purpose of this comparison, the obesity rate for each country and gender was computed from the closest Eurobarometer survey (No. 59.0), which was carried out in year 2003. The spearman rank correlation coefficient between this obesity rate and the percentage of individuals who think that being overweight is bad for their health is indeed low (0.10) and statistically insignificant (p=0.58).

[18] The cross sectional nature of the Eurobarometer 64.3 and its scarcity of economic indicators do not allow one to carry out more sophisticated analyses needed to draw causal inferences.

[19] Obesity does not meet the definition of addiction as clearly as tobacco consumption does. However, obesity influences the human body's homeostasis and can lead to habitual behaviours that are very difficult to modify (Roth et al. 2004).

properties of tobacco. Unfortunately, we are unable to provide empirical evidence on this issue due to the lack of suitable data.

Second, there may be lack of information regarding what constitutes healthy habits and, more specifically, the calorie content of purchased foods. This is the information aspect that the obesity literature has, directly or indirectly, referred to most often (Cawley, 2004, and Cawley and Variyam, 2006). We attempt to assess the relevance of this information deficit by looking at the percentage of European adults who declare that following a healthy diet is not easy because they "lack info about what constitutes a healthy diet", "lack info about the food they eat" and/or think that "information about healthy eating is confusing and contradictory". According to the results reported in Table 6, information problems appear to be particularly rare in two Northern European countries (the Netherlands and the UK) and more severe in Italy, Greece, France and Austria, but, on average, less than 9% of European adults declare not to find it easy to follow a healthy diet due to information problems. Hence, if we rely on European adults' self reported answers on the issue, lack of information is clearly not crucial to explaining why individuals do not find it easy to eat healthy.

Table 6 Percent of European Adults who don't Find it Easy to Eat a Healthy Diet due to Information Issues

	Women	Men
Germany	6.29	7.43
Denmark	6.52	9.07
Netherlands	2.15	2.16
Belgium	7.94	8.74
Luxembourg	11.99	12.25
France	13.13	12.69
UK	2.93	3.79
Ireland	5.35	4.13
Italy	15.93	17.95
Greece	13.11	16.63
Spain	6.73	6.28
Portugal	8.45	6.11
Austria	15.46	16.55
Finland	7.08	9.22
Sweden	5.36	6.61
All	8.35	8.80

Note: Statistics based on Eurobarometer Survey No. 64.3, 2005.

Finally, individuals may be unaware that they are overweight or obese even if their weight status should objectively be classified as such. No Eurobarometer survey contains information on both weight status and individuals' perceptions of their own weight. Instead, we rely on a recent sample of US individuals from the National Longitudinal Survey of Youth 1997 (NLSY97), which consists of youth aged 12-16 in 1997 who were subsequently re-interviewed on a yearly basis until 2005.[20] NLSY97 respondents were not only asked about their height and weight[21] but they were also asked to describe their own weight as "very underweight", "slightly underweight", "about right", "slightly overweight" or "very overweight".[22] In Table 7 we focus on the sample of US youth who are overweight (column 1) and obese (column 2) and report the percentage who misclassify their own weight and describe it as "about right", "slightly overweight" or "very overweight". The proportion of self-descriptions that do not match the objective BMI classification is remarkably high, especially among young males.

Table 7 US % of Youth who are Overweight (1) or Obese (2) but describe Their Weight Status as Right, Slightly or Very Underweight

	(1) Overweight	(2) Obese
All	32.34	14.00
Females	17.57	7.28
Males	44.78	20.69

Source: NLSY97.

This could be due to some sort of cognitive dissonance (obese individuals might like to think that their weight is not so high because their habits are more justifiable if they do so) and/or to the lack of the necessary information to identify excessive weight. When drawing parallelisms with smoking behaviour, it is worth noting that

[20] For further information about the NLSY97, see http://www.bls.gov/nls/handbook/2005/nlshc2.pdf

[21] Self-reported weight and height have been corrected using regression estimates from Cawley and Burkhauser, 2008.

[22] The Center for Disease Control (CDC) recommends using its gender and age-specific growth charts in order to classify weight status among individuals under the age of 21. In particular, youths are classified as "overweight" if their BMI is at or above the gender and age-specific 95th percentile and "ar risk of overweight" if their BMI is between the 85th and the 95th percentile. We use the adult obesity (BMI≥30) and overweight (BMI between 25 and 30) standards for all respondents, including those below 21 years old, to ensure comparability across individuals and over time. However, our results remain basically unchanged when using the CDC classification for youth.

this latter aspect may be relevant for the obesity phenomenon but of course it is unlikely to be an important issue in the context of smoking.

In sum, our results suggest that the majority of individuals are informed about the bad consequences of overweight and obesity on health and do not feel that following a healthy diet is difficult because of lack of information. Moreover, cross-country differences in obesity prevalence cannot be explained on the basis of lack of information. On the other hand, we find strong evidence that, at least among teenagers, individuals often fail to properly evaluate their own weight status.

3.2.2 Lack of Rationality

While they do not directly attempt to quantify the importance of self-control problems, Cutler, Glaeser and Shapiro (2003) suggest that lack of rationality may be relevant in explaining food consumption: "…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." (p. 112).

In our context, the most common source of lack of rationality is time inconsistency, which refers to individuals constantly reoptimizing over the short term, and quickly abandoning the long-term plan that was originally optimal: what is optimal today for someone to start tomorrow is no longer optimal once tomorrow comes. Finding empirical measures of time inconsistency is not an easy task. For the European adult population, the best approximation that we could find is the proportion of individuals who declare that following a healthy diet is not easy among those who have been on a diet over the past twelve months, reported in Table 8.

Table 8 Percent of European Adults who don't Find it Easy to Eat a Healthy Diet and Have Been on a Diet Over the Last 12 Months.

	Women	**Men**
Germany	36.49	36.36
Denmark	36.08	36.89
Netherlands	26.32	36.11
Belgium	38.35	32.69
Luxembourg	45.61	16.67
France	37.21	43.90
UK	27.62	32.52
Ireland	40.80	44.19
Italy	48.37	41.82
Greece	38.20	40.00
Spain	24.54	26.15
Portugal	31.09	25.71
Austria	48.21	54.55
Finland	41.09	35.71
Sweden	28.74	24.59
All	36.28	35.68

Note: Statistics based on Eurobarometer Survey No. 64.3, 2005.

The correlation between our measure of time-inconsistency and obesity at the country level is positive (0.25) but statistically insignificant. In most countries, at least one out of every four individuals who have been dieting declare that they do not find it easy. While this is a non-negligible proportion, the presented measure is a proxy and is probably an upper bound. For instance, individuals who have been dieting over the previous year and declare that following a healthy diet is not easy may not have changed preferences over time. Instead, they might be simply expressing a judgement regarding the difficulty of a certain task while sticking to their original plans and experiencing no disagreement between their past and present selves. We would expect, however, that stating that following a healthy diet is difficult may be indicative of dynamic inconsistency for at least a proportion of the individuals in our sample. Hence, we are inclinded to interpret the figures reported in Table A4 as an upper bound on the degree of dynamic inconsistency among European adults.

As for the US, we have been able to build a better proxy for dynamic inconsistency by exploiting the longitudinal nature of the NLSY97 as well as its richness of information on weight-related aspects. Specifically, we focus on the sample of youths who, at time t, declare to be trying to lose weight, and compare their BMI at time *t* and *t+1*. In Table 9 we report the percentage of failed weight loss attempts using two alternative definitions of “failed attempt”: column 1 displays the percentage of youths whose BMI at *t+1*, despite having declared to be trying to lose weight, is less than a (gender, year and age-specific) standard deviation lower than their BMI at t; column 2 instead uses a less demanding definition and classifies as failed weight loss attempts all those cases in which the BMI at time *t+1* is not lower than the BMI at time *t*.

The message from the first two columns of Table 9 is clear: time inconsistent preferences regarding weight is a very common problem among teenagers, since the majority of them end up failing to reduce their BMI after having declared to be trying to lose weight.[23] One obvious objection to this measure is that some of the unsuccessful weight loss attempts that we have identified could have been the result of a re-optimization taking place between *t* and *t+1* because some unexpected shock occurred during those twelve months. An intuitive example of such a shock is pregnancies, which have already been removed from the above analysis. However, new information arrivals that could make the initial diet plan no longer desirable are not restricted to pregnancy. In order to check how vulnerable our results are to this criticism we have re-computed the percentage of unrealized weight loss attempts on the sample of youth whose family structure remains unchanged between *t* and *t+1* and on the sample of white individuals, who are less prone to earnings instability. Our results are reassuring: the percentage of unsuccessful weight loss attempts remains broadly unchanged even when we focus on these sub-groups of individuals.

Table 9 Failed Weight Loss Attempts (%) among US Youths

	All		**Unchanged Family Structure**		**White**	
	(1)	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**
All	93.18	57.05	93.50	57.80	93.53	56.55
Females	93.00	53.76	92.98	54.30	93.36	52.58
Males	93.53	63.33	94.45	64.30	93.88	64.48

Source: NLSY97.

Although we find evidence that individuals often fail to properly evaluate their own weight status, our results regarding information problems seem to suggest that their relevance may be limited: most individuals declare to be aware of the health consequences of obesity, a relatively small percentage of them find it hard to eat healthily because of information deficiencies and these indicators are not significantly related to aggregate measures of obesity prevalence. However, we do have stronger evidence on time inconsistency: the majority of teenagers fail to reduce their BMI after having declared to be trying to lose weight. This is an important result because of the welfare implications of technical change when there are self control problems. As Cutler et al. (2003) argue, technological innovation that reduces the time costs of food preparation affects food consumption by reducing the price of food and by reducing the delay before consumption. While the price reduction affects all, the reduced time delay will mostly affect individuals with self control problems, who will likely spend more than is optimal on food and incur a welfare loss if the health costs of additional weight due to overconsumption[24] are greater than the welfare gain from lower costs of time food preparation.

3.3 Equity Issues

The negative relationship between obesity and socioeconomic status (SES hereafter) has been documented in numerous studies. For example, Chou, Grossman and Saffer (2004) find that tears of formal schooling completed and real household income have negative effects on BMI and the probability of being obese for US adults. However, there are two main reasons why giving this negative BMI-SES correlation a causal interpretation may be misleading. First, there is some evidence indicating that obesity lowers individuals' wages (Cawley, 2004b); hence, reverse causality may be playing a role. Second, both SES and BMI could be the consequence of individual choices as well as of circumstances beyond individuals' control. Policy intervention because of equity considerations is justified by the latter

[23] Similar results, not reported, are obtained when considering two year intervals.

but not by the former.

One way to get around these problems is to link individuals' BMI to their parental background rather than to their own SES, given that parental background is not something that individuals get to choose. Moreover, reverse causality is no longer a concern since individuals' BMI is unlikely to determine their parents' SES.[25] Consistent with this idea, Baum and Ruhm, 2007, investigate the obesity-SES relationship by choosing as the main proxy for SES the educational attainment of individuals' mothers. To this purpose, they use US data on young adults from the National Longitudinal Survey of Youth of 1979. Their main findings are that young adults' BMI is indeed negatively related to their mothers' educational attainment and that these SES disparities in obesity grow with age. This result is in line with the findings of Case, Lubotsky and Paxson, 2002, who analyse other health conditions and health status indicators and conclude that the SES-health gradient in the US becomes steeper as children move from infancy through late adolescence. Two main reasons have been proposed for this steepening gradient: that low SES individuals are both more likely to suffer negative health shocks and less likely to be able to recover from them.[26]

In order to add new obesity-related evidence to this debate we complement Baum and Ruhm's, 2007, analysis in two important ways. First, we provide new evidence for Europe in order to assess whether our conclusions are similar to those reached by Baum and Ruhm, 2007, for US young adults. This is of interest given the contrasting institutional structure of the US and the European countries considered. In order to carry out this analysis, we link ECHP young adults to their parents.[27] Second, unlike previous studies that have solely focused on parental

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[24] Another welfare cost from overconsumption for an individual with self control problems may be the reduction in consumption from other goods beyond what a rational person would do. However, Cutler et al. (2003) argue that this is mechanisms is unlikely to be important.

[25] One might still be concerned that this empirical strategy does not allow one to disentangle the impact of parental SES from the impact of other unobserved factors associated with parental SES and that are transmitted from parents to their children. However, our purpose is to assess the importance of equity considerations related to obesity, so inasmuch as these unobservables are intergenerationally transmitted and not a result of individuals' choices, we believe that they are part of the effect that we want to estimate.

[26] The evidence in Currie and Stabile, 2003, favours the former explanation over the latter.

[27] The household nature of the ECHP only allows one to do so when parents and children are cohabiting; as a result, we are forced to rely on a sample of young adults which is not evenly distributed across European countries. For this reason, the results reported are based on countries were cohabitation rates are higher: Ireland, Italy, Greece, Spain, Portugal and Austria. However, our conclusions remain basically unaltered if we add Denmark, Belgium and Finland to the analyses. These results, not presented, are available upon request from the authors.

socioeconomic background, we attempt to disentangle the effect of family background into a nature and a nurture component. That is, we analyse how individuals' BMI is influenced by both their parents' SES and by their genetic inheritance (for which we use the BMI of individuals' biological mother as a proxy),[28] being parental SES closer to measuring nurture effects and maternal BMI intended to capture nature effects.

We follow Baum and Ruhm, 2007, and use maternal education as our main proxy for parental SES. This choice is not only meant to facilitate comparability of results but is also motivated by previous studies suggesting that maternal education is more related to child health than fathers' schooling (Currie, Shields and Wheatley Price, 2007) and by the fact that socioeconomic data is more often missing for fathers.

Table 10 The Impact of Family Background on the BMI of European Young Adults: Random Effects Estimates

	(1) BMI	(2) BMI	(3) BMI
Female	-1.137***	-1.135***	-1.120***
	[-25.80]	[-25.77]	[-25.38]
Age	0.118***	0.080***	0.075***
	[47.96]	[7.00]	[6.60]
Mother's Years of Schooling	-0.032***	-0.082***	-0.093***
	[-5.47]	[-4.38]	[-4.93]
Mother's Years of Schooling*Age		0.001***	0.002***
		[2.79]	[3.70]
Mother's BMI	0.115***	0.089***	0.089***
	[29.71]	[7.99]	[8.00]
Mother's BMI*Age		0.001**	0.001**
		[2.49]	[2.45]
Years of Schooling			-0.029***
			[-5.71]
N. Obs.	38139	38139	38139

Source: ECHP. Countries: Ireland, Italy, Greece, Spain, Portugal and Austria. *** p<0.01, ** p<0.05, * p<0.1. T-statistics are displayed in square brackets. Additional regressors are year and country dummies.

[28] According to Comuzzie and Allison, 1998, 40 to 70 percent of the variation in obesity-related phenotypes in humans is heritable.

Our results are reported in Table 10. Estimates from Column (1) indicate that, in line with the previous literature, individuals with higher parental SES have significantly lower BMI. In particular, we find that an additional year of maternal schooling reduces individuals' BMI by 0.03 kg/m2, approximately the same impact that four years of age have on BMI. An important result is that the mother's BMI is found to be positively associated with the BMI of her children: an additional BMI point for mothers is associated with an increase in their children's BMI of 0.11 kg/m2, almost the same impact that an additional year of age has. These differences are all statistically significant. In Column (2), both our parental background measures are interacted with age in order to assess whether the previous relationships are weaker or stronger for older individuals. Column (3) adds individuals' years of schooling to the list of regressors since this has been shown to be the most important mechanism through which parental background affects individuals' BMI (Baum and Ruhm, 2007).

Our evidence indicates that, in line with the results for US young adults reported by Baum and Ruhm, 2007, there is a SES gradient in BMI for European young adults as well (Column 1). However, while in the US the SES gradient steepens, in Europe the relationship between maternal education and BMI becomes weaker for older individuals (Column 2),[29] being this result statistically significant as well as robust to the inclusion of individuals' years of schooling in the regression (Column 3). Although only suggestive, this could imply that the European welfare state mitigates the effect of SES differences while these are exacerbated in the U.S.

Regarding genetic inheritance, we find that the relationship between individuals and their mothers' BMI instead becomes stronger with age. What this result means is unclear. One interpretation is that unlike for SES differences, institutions are not effective in mitigating background differences when these are related to genetic traits. The question of life-cycle divergence or convergence is extremely important in designing policies because it suggests pathways through which these differences can be undone.

[29] It is worth noting though that the SES-BMI gradient is reduced at a low rhythm: for instance, when controlling for individuals' education, it takes around 37 years to eliminate the impact of an additional year of maternal education (-0.09328+ 0.00255* 36.58=0).

3.4 The Health Care Costs of Obesity and the Insurance Externality

Obesity has, through its associated health problems, a substantial impact on health care expenditures. Recent evidence for the US suggests that the annual medical expenditures of obese adults are 37% higher than expenditures of healthy-weight individuals (Finkelstein et al., 2003a; Sturm, 2002; Lakdawalla et al., 2005). Moreover, Wolf and Colditz (1998) and Finkelstein et al. (2003b, 2004) estimate that the aggregate annual obesity-attributable medical costs in the US are between 5% and 7% of annual health care expenditures.

Comparable evidence from other countries is limited. Detournay et al. (2000) estimate that aggregate annual obesity-attributable medical costs in France range from 0.7 to 1.5% of total expenditures. Laird Birmingham et al. (1999) find an estimate for Canada between 1.1 and 4.6% of total expenditure. Sanz-de-Galdeano (2007) focuses on doctor visits in the ECHP and finds that the use of general practitioners is systematically higher among obese individuals and holds for most countries covered by the ECHP.[30]

Health expenditures attributable to obesity are important for two reasons. From a public finance perspective, it is important for policymakers to find out how much obesity costs in terms of health expenditures. This informs on possible fiscal pressures imposed by different public health scenarios in the future. The other reason is the potential externality created by health insurance. In almost any health insurance system there is some degree of risk pooling, given that weight is not used to charge differentially for insurance coverage. Under actuarial fairness, premiums would be set to equal expected health expenditures and since those expenditures are higher for the obese, premiums would also be higher for them. Generally, if risks differ in the population but individuals pay the same premium, this will create a positive subsidy for some individuals and a negative subsidy for others. The

[30] To our knowledge, there are few studies that find lower lifetime expenditures for the obese. The study of van Baal et al. (2008) is an exception. They find that because of lower life expectancy, obese individuals in the Netherlands actually have lower lifetime spending.

difference between lifetime expenditures and premium contributions gives the size of the insurance subsidy.

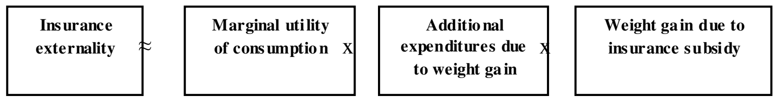
But the subsidy in itself does not lead to an efficiency loss. If weight is determined exogenously, there is no welfare loss. Those who are born with higher weight receive an implicit subsidy given by the difference in lifetime expenditures and premiums. For some people, weight might be predetermined from early childhood or from genetics as we have seen in section 3.3. There might be support for such transfers on equity grounds and it does not entail a welfare loss because conditional on endowments, resources are efficiently allocated.

There is an important distinction between the insurance subsidy and the insurance externality. The subsidy is a necessary condition for the externality but is not sufficient. There needs to be a change in behaviour in response to the subsidy to yield an externality. The externality arises only when weight is partially under the control of the insured through "consumption" and "expenditure" of calories. In that case, the insurance subsidy could lead to a difference between the privately optimal weight level and the socially optimal weight level.

As Bhattacharya and Sood (2007) demonstrate, those at the margin (those whose expected health expenditures are equal to the premium under risk pooling) will increase their weight in response to a change from actuarial fairness to pooling. The main reason is that the monetary benefit to weight loss (lower premiums) that exists under risk-rating vanishes as the degree of pooling increases.[31] This form of moral hazard leads to a welfare loss. The size of the externality for those at the margin is proportional to the additional life-time expenditures due to increased weight and the sensitivity of optimal weight to risk pooling. The insurance subsidy leads to a difference between the privately optimal weight level and the socially optimal level.

[31] This result is fairly general for those at the margin: i.e. for those that do not receive an ex ante subsidy due to initial weight. For those that receive a ex ante subsidy, under risk pooling, the change to risk-rated premiums imply both income and price effects that work in the same direction if weight (or more plausibly food consumption) is a normal good: optimal weight will be lower under risk-rating. However, for those receiving a negative subsidy, income and price effects work in opposite direction so that the effect is indeterminate.

Figure 8 The Insurance Externality



The literature we surveyed above has generally focused on the second term and asked whether life-time expenditures differ by weight. The general conclusion is that expenditures increase with weight. However little has been done on the last term. There is generally not enough variation across time or regions to identify a behavioural response, nor is it easy to quantify the insurance externality for lack of data. Bhattacharya and Sood rely on a structural model to identify this response and find that in the U.S., the externality represents a relatively small $149 per individual.

Several factors will affect the size of the externality. Three are likely to vary across countries: the extent of risk pooling in public and private insurance schemes, the generosity of insurance schemes, and the difference in lifetime expenditures between obese and non-obese. In Table 11, we present key characteristics of health insurance systems across OECD countries that directly inform on the first two factors determining the size of the obesity externality, the extent of risk pooling and the generosity of insurance systems.

Public insurance schemes will seldom allow for risk rating of premiums for equity reasons but also because expenses are financed either through a flat contribution rate or through taxation. The fraction of individuals covered by a public health scheme is likely to be a good proxy for the degree of risk pooling. Except for the U.S., public health schemes are predominant in OECD countries and even when public health insurance is provided through sick funds such as in Germany and the Netherlands, strict regulations usually strongly limit risk-rating. In the U.S. about a fourth of the population, mostly the elderly, is covered by public insurance. Only 44% of total health expenditures are financed through the public system. On the other hand, most workers rely on employers to provide health insurance, which means that the U.S. has roughly 60% of its population relying solely on private health insurance.

Private health insurance is unique in the U.S. because for most workers it is provided by the employer. This allows health plans to do risk-rating at the firm level but does not allow to rate workers directly. Hence, there is still some degree of risk pooling, albeit less than in a public system. Some restrictions also exist that limit risk-rating in the U.S. For example, some states forbid insurers from using health risk classifications when determining premiums or limit the use of geographical variation in setting premiums. Total outlay by private insurers represent 42% of total cost in the U.S. while a remaining 14% is paid directly by individuals through deductibles and co-payments for health services (so-called out-of-pocket expenditures).

Private insurance is generally less present in European countries. But few restrictions are imposed on how private insurers are allowed to set premiums. It is interesting to note that in many European countries, the amount of total expenditures paid for by individuals themselves (out-of-pocket expenditures) is heterogeneous, ranging from 7.8% in the Netherlands to 44% in Greece. Therefore, in countries such as Greece, Italy and Spain it is unclear how much risk pooling exists. On the one hand the existence of universal health systems gives an indication of high degree of pooling in Europe while on the other hand high out-of-pocket expenditures imply less pooling in some countries. Yet since private health insurance is largely underdeveloped in Europe relative to the U.S. we can conclude that the insurance subsidy is likely to be higher in most European countries, particularly in countries such as France, Germany, U.K., Sweden and Netherlands.

We move next to the computation of the additional expenditures obese individuals incur relative to the non-obese. Although annual cost estimates are interesting in themselves, a lifetime measure of costs might be more desirable since early interventions might have long term effects on health and eventually expenditures. Furthermore, from a lifetime perspective, it is a priori ambiguous whether the obese have higher expenditures than the non-obese. Just like smokers, it is possible that obese persons die earlier, hence reducing lifetime expenditures relative to a non-obese person.

Estimates of lifetime costs are available from various studies for the U.S. but not for Europe. Hence, we follow Lakdawalla et al. (2005) and use a transition model that tracks health trajectories of individuals and impute total medical expenditures for Europeans using SHARE data. Such a strategy recognizes that the early onset of obesity has both a direct effect on expenditures but also an indirect effect through health conditions such as hypertension and diabetes that may elevate the risk of heart disease and eventually mortality.

Table 11 Public Provision of Health Care Across Countries

	Public Insurance Scheme			Private			
Country	Pop Covered	% Pop Covered	Premiums	Nature	Restriction on Premiums	Out of Pocket Exp as % of Total Health Expenditure	Public Health Expenditures as % of Total Health
Austria	All employed, self-employed and unemployed, pensioners	~100	Contributions and user charges (7.4% employee employer)	supplementary (38%)	None	17.5	69.3
Denmark	Universal	~100	Taxation	complementary (30%)	N/A	15.8	82.7
France	All employed, self-employed and unemployed, pensioners	96	contributions	complemenary (95%)	N/A	10	75.9
Germany	All employed, (up to income limit) and unemployed, pensioners	87	Sickness Fund contributions (7.15% employer-employee)	primary (high income), 10%	Few, allowed to be based on age of entry, gender and health risks	10.4	78.6
Greece	Universal	~100	Contributions (2.55% employee and 5.10% employer)	duplicate, supplementary (100%)	None	46.5	53.3
Italy	Universal	~100	Contributions & Taxation (1% employee, 13% employer)	supplementary (16%)		19.6	75.1
Netherlands	Universal (earnings below threshold)	75.6	Sickness Funds contributions	supplementary (28%)	None	7.8	66
Spain	Universal	~100	Taxation	supplementary (19%)	None	23.7	71.4
Sweden	Universal	~100	Taxation	inexistant		n.a.	85
U.K.	Universal	~100	Taxation	supplementary (12%)	None	10.9	82.4
U.S.	Persons 65+ or low income	24.7	Contributions & Taxes	voluntary (60%)	restricted at state level for small groups and some limit community rating	14.1	44.2

Source: *Health Insurance Coverage, Public and Private Schemes* (2000) OECD. WHO World Health Statistics 2005, www.who.int

Notes: Figures in last two columns taken as average of 2001-2002. Public health expenditures are defined by the WHO as the sum of outlays on health paid for by taxes, social security contributions and other external sources.

The two forces at play in such models are the following: as documented earlier obese individuals have higher risks of contracting heart disease, hypertension, diabetes, having a stroke and eventually becoming disabled. These forces tend to increase lifetime costs. On the other hand, the public health literature has failed to reach a consensus on the size of the mortality effects of obesity, particularly at older ages. The macro exercise we performed tends to suggest a modest negative effect of obesity on survival. As we show later, we find similar evidence using longitudinal micro-data.

We consider the age 55+ population where most of health care costs occurs (that would not be true for premium payments). We use panel data from the Health and Retirement Study (HRS) to construct a transition model for six broad health conditions (hypertension, heart disease, stroke, lung disease, cancer, diabetes and mental illness). Mortality and disability (measured by limitations with activities of daily living) are added to the transition model. Each transition across health states depends on current health conditions as well as risk factors such as being obese and being a smoker (or past smoker). It also depends on standard demographic characteristics. We adapt the model to Europe by adjusting baseline transition rates of the U.S. transition model such that we match in simulation the age-specific prevalence rate observed in the SHARE data. See Appendix B for details on the computations. Because of relatively small samples in each country for this exercise, we pool all European countries together. Therefore, our calculations are only suggestive since better longitudinal health and expenditure data from Europe would be needed.

We compute for each year the average medical expenditures of each individual in the simulation. For that purpose, we use total health expenditure (including drugs) information in the Medical Expenditure Panel Survey (MEPS) and regress it on prevalence of health conditions in the model as well as demographics and controls for risk factors. Average expenditures in the U.S. are quite similar to those found in the literature. Expenditures in Europe could be different because of differences in medical practice and/or medical costs or technology. Since information on total health expenditure is lacking in SHARE, we construct a price deflator using OECD average health expenditures per capita. We do so by taking account of differences in income and health across countries and use the deflator to adjust European predicted expenditures that are derived using U.S. regression estimates. We estimate that keeping income and health constant, health expenditures are 42.2% lower in Europe than in the U.S. See Appendix B for details on these computations.

We then simulate health trajectories of hypothetical individuals. We estimate the difference in life-time costs of obese and non-obese individuals. Since the obese and non-obese differ along other dimensions (such as pre-existing conditions, demographics) we consider the difference in outcomes between a scenario where we hypothetically "turn" every respondent obese and another when they are not obese. Table 12 reports the results.

Table 12 Lifetime Outcomes of Obese and Non-Obese Individuals as of Age 55

Excess (Relative to Non-obese)	U.S.	Europe
Lifetime health expenditures ($)	19,989	15,567
Life expectancy at 55 (years)	-0.401	-0.323
Expected time disabled as of 55 (years)	2.45	2.56

Notes: average for obese minus non-obese over 50 replications

We find that an obese American at age 55 faces on average an additional $19,989 in health expenditures. In Europe, the same figure is slightly lower, $15,567, reflecting mostly differences in average costs across countries but also better baseline health in Europe. As can be seen from the second line in the same table, obese individuals have slightly lower life expectancy. But the largest effect of obesity is to lengthen the expected amount of time spent disabled. We simulate that the obese should expect to spend roughly an additional 2 and a half years disabled compared to the non-obese. These effects are roughly similar in the U.S. and Europe. Consistent with Lakdawalla et al. (2005) these simulations show that the disability effect dominates the counteracting effect of lower life expectancy both in the U.S. and Europe.

To judge the magnitude of the externality, it is important to attribute total health expenditures to public, private and out-of-pocket (OOP) expenditures. For lack of good micro data, we use the OECD numbers in Table 11 to adjust these expenditure figures. Clearly the out-of-pocket portion of these expenditures should be taken out of the calculation since there is no insurance for that portion of expenditures. Since the share of out-of-pocket expenditures varies across countries in Europe, we can use a range from 10% to 30% to capture this variation and 14.1% in the U.S. The reminder is shared unequally between private and public sectors. We can classify for our purposes European countries as part of one of two "systems" that emerge from observing data in Table 11: a system with relatively lower public involvement and higher OOP (representing some Southern European countries such as Greece, Spain and Italy) and a system with high public involvement and low OOP (Central and Northern Europe, except Denmark and Austria). Using the numbers in Table 11, we get the following distribution of additional expenditures in the three regimes.

Table 13 Distribution of Additional Health Expenditures By Source

			Europe			
	%	US	%	high OOP	%	low OOP
Out-of-Pocket	14	2,806	30	4,670	10	1,557
Private	42	8,297	10	1,557	10	1,557
Public	44	8,795	60	9,340	80	12,454
Total		19,898		15,567		

Notes: based on OECD figures and simulation results.

In the high OOP regime, it is unclear whether pooling is more important than in the U.S. since a large fraction of additional expenditures are out-of-pocket. The average additional expenditures that would fall under the public regime are roughly similar to those in the U.S. ($9,340 compared to $8,795 in the U.S.). In countries where the public insurance scheme covers a larger share of expenditures, pooling is likely to be more important. The additional expenditures that fall under the public system are higher in Europe than in the U.S. ($12,454 compared to $8,795). Hence, there is likely more pooling in Northern and Central European countries (except Denmark and Austria) than in the U.S. and Southern Europe.

If the behavioural response to the subsidy is similar across countries, one would therefore expect the obesity externality to be higher in these countries than in say Italy, Spain, Greece or the U.S. The fact that obesity is higher in the U.S. than it is in Northern European countries provides a rough indication that the behavioural response is likely to be small despite a large insurance subsidy. Otherwise, those countries would have higher obesity rates than the U.S. holding everything else constant. This interpretation would be broadly consistent with the finding of Bhattacharya and Sood, who report a modest externality (of the order of less than 150$ per individual). Since our calculations are only suggestive, more research should be directed towards calculating the size of the behavioural response to the insurance subsidy.

Even if the externality is relatively small, policymakers should worry about the consequences of obesity for health expenditures. In projecting future expenditures, few government agencies incorporate the current trends in obesity with its consequences such as diabetes, hypertension and heart disease. Next, we modify the simulation so that we can calculate the long-term financial consequences of the current obesity trends in the U.S. and also assess how expenditures would increase in Europe if the U.S. trend was to be experienced in the future.

Estimates of the projected trend in the U.S. are taken from Ruhm (2007) and reproduced in the next table as the "Pessimist scenario". Projected prevalence of obesity among those aged 55 in 2040 would be 63% higher than it is today which effectively means that 58% of Americans would be obese at that age. Although this might be a realistic scenario for the U.S., it is probably a more pessimistic scenario for Europe. According to OECD data most European countries experienced a relatively low growth rate of obesity relative to the U.S. during the 1990s, although this could change in the future. Under the pessimistic scenario, obesity would increase from 16% to 26% among Europeans aged 55 (see Table 14).

We consider two other scenarios: a medium scenario in which the average growth rate in the prevalence of obesity is halved relative to the pessimistic scenario. This implies that the new cohort in 2040 has a 26% higher obesity rate than in 2004. The last scenario, denoted as optimistic, assumes no trend in obesity. This last scenario is likely to be optimistic for both the U.S. and Europe. The weights of entering cohorts are also adjusted using population projections to match aggregate changes in the size of that cohort. Overall, the simulated population in

2040 tends to match well with UN projections both for the U.S. and Europe. This means the model captures well the demographic transition in both regions.

Table 14 Obesity Trend Scenarios

		Fraction Obese in a Year relative to 2004			
Obese (BMI >=30kg/m^2)	Avg Annual Growth Rate	2004	2010	2030	2040
Optimistic Scenario	0.00%	1	1.000	1.000	1.000
Medium Scenario	0.64%	1	1.039	1.181	1.260
Pessimistic Scenario	1.28%	1	1.11	1.48	1.63

Notes: Pessimistic scenario based on projections for the U.S. by Ruhm (2007)

Both aggregate and per capita figures are reported in Table 14. One can see that health care costs for the 2040 cohort are much higher in the Pessimist scenario for both the U.S. and Europe. The difference in aggregate lifetime expenditures reaches $USD 140 billions in the U.S. while that figure is much lower in Europe ($USD 26 billions). On a per capita basis the corresponding numbers are roughly $7,500 per capita in the U.S. and $1,600 per capita in Europe. In absolute terms, the increase in obesity is higher in the U.S. than in Europe which could explain the difference (level effect). Second, aggregate costs are generally lower in Europe (because of lower disease prevalence and lower price).

Table 14 Expected Lifetime Health Care Spending for Age 55-59 Cohort in Selected Years

Scenario	Age 55 Health Care Costs US			Age 55 Health Care Costs EU		
	2010	2030	2040	2010	2030	2040
Optimistic	4.3354	4.3345	4.3403	2.173	2.169	2.168
Medium	4.3423	4.3779	4.4049	2.174	2.177	2.180
Pessimistic	4.3495	4.4282	4.4847	2.176	2.187	2.194
	Per Capita Health Care Costs US			Per Capita Health Care Costs EU		
	2010	2030	2040	2010	2030	2040
Optimistic	231,133	231,079	231,426	127,167	126,920	126,905
Medium	231,506	233,415	234,891	127,241	127,415	127,620
Pessimistic	231,888	236,123	239,174	127,316	127,989	128,503

Notes: Lifetime Figures in Top panel in trillions $USD 2004. Figures in bottom panel in $USD 2004.

Most of the cost increase arises due to an increase in the expected number of years spent disabled as shown in Table 15. As shown previously the disability effect dominates the mortality effect in our calculations. This tends to illustrate that forecasting models that only take into account the projected reduction in life expectancy will fail to capture the increase in expenditures due to the increased prevalence of obesity. Whether this omission is important or not needs to be addressed using better health and costs data from Europe.[32]

Table 15 Changes in Life and Disability-Free Life Expectancy

Relative to Optimistic	Change Life Expectancy at 55 US			Change in Life Expectancy at 55 EU		
	2010	2030	2040	2010	2030	2040
Medium	-0.014	-0.084	-0.119	-0.011	-0.065	-0.102
Pessimistic	-0.027	-0.181	-0.266	-0.023	-0.140	-0.228
	Change Exp. Disability Free Yrs US			Change Exp. Disability Free Yrs EU		
	2010	2030	2040	2010	2030	2040
Medium	-0.030	-0.181	-0.257	-0.017	-0.097	-0.156
Pessimistic	-0.061	-0.396	-0.585	-0.034	-0.210	-0.350

Notes: Figures are reported as the difference in expected years relative to the optimistic scenario

To summarize, we find that although the insurance subsidy might be large in some European countries due to the lack of risk-rating of insurance premiums and despite the higher life-time health expenditures the obese incur, the insurance externality is likely to be limited because the behavioural response to the subsidy is small based on available evidence.

4. Policy Discussion

Are there economic rationales for public intervention to control obesity? While the goal of public health is to promote the health of the population, economics focuses on how lifetime utility is maximized given the existence of resource constraints, with health being only one argument in individuals' utility

[32] It is interesting to compare our estimate of the effect of obesity on life expectancy with the macro evidence reported in section 3.1.1.2, Table 5. There we found that for a 10% drop in the obesity rate, there was a decrease in life-expectancy at birth of 0.291%. From our estimates, we find that for a 63% drop in obesity at age 55 (in 2040) leads to a 0.266 change in life expectancy at age 55. Since life-expectancy at age 55 is 27.2 in the simulation, this represents a 1% change in life expectancy.

function. From an economic standpoint, public intervention is justified on the basis of equity concerns and/or when there are efficiency losses caused by market failures. We have investigated the relevance of these issues in order to assess if and on which grounds public intervention is recommended.

When we consider equity there is a clear conclusion: obesity cannot be entirely the result of individual choice since BMI is significantly affected by parental background both in the US and in Europe. Interestingly, we also find that the BMI of individuals from low and high socio-economic status slowly converges over the life-cycle in Europe, while it diverges in the U.S. Although more research is needed in this area, this result suggests that the European welfare state mitigates SES differences while these are exacerbated in the U.S.

As for efficiency, we have classified market failures into three main categories: productive inefficiencies, lack of information or rationality and health insurance externalities. We have shown that, when there are product and labour markets imperfections, private and socially optimal body weight will differ if obesity affects productivity and/or the wages of obese individuals differ from those received by their equally productive but non-obese counterparts.

There is evidence that obesity affects productivity, through various channels including education and health, although the magnitudes of the effects are unclear. We have also found suggestive evidence that employers in countries where it is easier to discriminate against the obese – because of the rents associated to product market regulation - do appear to offer lower wages to the obese compared to the non-obese. Policy implications depend on the relative size of these effects. In particular, if the productivity effect is large relative to discrimination, then the efficient body weight is lower than the privately optimal level, and measures that reduce the latter are in order. On the other hand, if discrimination prevails on productivity effects, the privately optimal level is lower than the social optimum, and the direction of policies should vary accordingly.

How important are these inefficiencies and do they vary across countries? This is a difficult question, and we organize our our answer in the following two

So the implied change for a 10% drop in obesity is 0.145%. Hence, we can conclude that magnitudes are roughly similar using different approaches.

points. First, discrimination effects appear to be larger in the countries with higher product market regulation, and the higher regulation the wider the gap between privately and socially optimal BMI. Second, the current broad trend in favour of deregulation, documented for instance by the OECD, suggests that these inefficiencies are likely to decline in importance in the future as barriers to entry and other quantitative restraints to firm entry are progressively removed.

Regarding information deficiencies, our results indicate that they are unlikely to be a major issue. The majority of individuals are aware of the health consequences of obesity and rarely declare that having limited information makes it hard for them to follow a healthy diet. Therefore, we do not believe that initiatives related to food labelling requirements or advertising of the health consequences of obesity should be a top priority for policy makers. Actually, the effectiveness of food labelling has been shown to be quite limited (Cawley and Variyam, 2006).

Our evidence on time inconsistency, however, is stronger, and shows that a very high proportion of individuals seem to have self-control problems when it comes to weight management. Given that individuals with self-control problems are those most responsive if the time delay before consumption is reduced, we believe that further research should be devoted to analysing the effects of regulations that affect fast food advertising and the location and access to fast vending machines and fast food establishments (Chou, Rashad and Grossman, 2005, Acs, Cotten and Stanton, 2007, Chou, Grossman and Saffer, 2004).

An alternative means of reducing obesity is food taxes, but this measure is controversial. Smoking is not necessary, but eating is, so a uniform tax on all foods would be regressive and not even an answer to the problem at hand, since ideally one would only want to tax excess food consumption. Rather than tax all foods, more complex schemes might tax the foods contributing most to obesity (Elston et al., 2007): taxes could be linked to characteristics of foods that contribute to obesity (for example, the content of high-fructose corn syrup) or they could be applied to specific categories of foods, such as prepared foods, snack foods and soda, in line with the "junk food tax" recently discussed by the WHO. The effectiveness of these type of taxes depends on how responsive consumers are to price increases and on whether they substitute away from the taxed goods in a way that obesity is actually reduced. Moreover, low SES individuals are likely to be more affected by most forms of food taxes. This is why it has been suggested that revenues generated by food taxes may be devoted to funding other obesity policies such as subsidizing healthy foods for the poor.

Finally, our analyses indicate that the size of the health insurance externality related to obesity is likely to be small. Although further research is needed, our evidence suggests that a market failure in the form of a behavioural response to the insurance subsidy is unlikely to be relevant in this context. However, from a public finance perspective, it is important to be aware of the expected health expenditures attributable to obesity under different scenarios. Accounting for effects on longevity is not enough because the obese can expect to spend a higher number of years disabled, conditional on survival, which raises their lifetime health expenditures.

So one might ask, what governments are currently doing to address the rise of obesity? The answer is that general goals are being laid down but a set of extensive policies has yet to emerge either from the U.S. or Europe. In 1994, the U.S. government passed the National Labeling and Education Act (1994) requiring manufacturers to include labelling information about their products but this did not apply to restaurants where Americans increasingly consume their meals. In 1998, the Nutrition and Physical Activity Program to Prevent Obesity and Other Chronic Diseases (NPAO) was created to work in partnerships with states to implement a number of nutrition and physical activity strategies. To date this program covers 28 states. The program is very much based on informing individuals, particularly the young, about good eating habits and physical activity as well as restricting the offer of junk food and soft drinks in schools. Funding of these programs is reviewed based on a set of performance measures but little is known of their effectiveness. Selective taxation of food in the U.S. is not common, hence making a proposal to introduce a tax on junk food is a novelty rather than a modification of the current tax regime. Instead of relying on taxation, some cities, such as New York and Philadelphia, have banned unsaturated fat, known to lead to coronary heart disease, from being used by restaurants. Overall, the policy response in the U.S. can be characterized as one primarily focused on education and targeted mostly to children with some more aggressive policies being implemented in some cities.

As for Europe, EU interest in health has grown slowly and usually in response to crisis and most public-health initiatives in both the EU and wider Europe are proposed at the local or national level (Lang and Rayner, 2005). While obesity is no exception to this general pattern, it has started getting increasing attention from the EU and WHO Europe. European health ministers from 53 countries recently approved the European Charter on Counteracting Obesity[33], drafted by the WHO Regional Office for Europe. The Charter pays special attention to vulnerable individuals, such as lower socioeconomic population groups, children and adolescents and it clearly calls for regulations to substantially reduce the extent and impact of commercial promotions of energy-dense foods and beverages, particularly to children, with an eventual move to adopting an international code of practice. At the moment, there is a wide variety of practices across Europe: in some countries (Sweden, Norway) junk food ads for children are banned while in others (Spain, Portugal, the Netherlands) the corresponding industries engage in self-regulation. The UK Department of Health has recently identified a broad strategy to stop and eventually over-turn the significant increase in obesity rates in the country. The strategy includes policies for children and measures promoting healthier food choices and increasing physical activities (UK Government 2008).

According to the European monitoring network ENHIS, funded by WHO Europe and the European Commission, there is a reasonably high degree of implementation of policies to reduce childhood obesity in Europe. In a recent study ENHIS (2007) considers 12 such policies[34] during 2005-2006, and ranks 25 European countries according to the degree of implementation of these policies. They find that implementation rates are relatively high in the Netherlands, Spain and the UK and relatively low in the Czech Republic and the Balkan countries, with the most implemented policies being those requiring recommended nutrient reference values and labelling of foods with nutritional information.

As transatlantic concern about the obesity epidemic raises, we expect

[33] See http://www.euro.who.int/Document/E89567.pdf.

[34] These policies are organized in five groups: 1) marketing and labelling; 2) healthy diet and nutrition; 3) physical activity; 4) education; 5) implementation structures.

national countries to increase efforts aimed at improving life styles and curbing health expenditures associated to an increasingly obese population. Our paper suggests that policy intervention may be warranted not only because of health concerns but also from a broader economic perspective, which takes into account both equity and efficiency issues.

Appendix A: Obesity, wages, productivity and efficiency

This appendix presents a simple economic model that illustrates reasons why privately optimal and socially optimal body weight can deviate, thereby justifying government intervention. Consider a prototype economy with L ex-ante homogeneous consumers and m firms. The product and labour markets are imperfectly competitive: pricing is a mark-up on marginal costs, consumers-workers bargain with firms about their wages and employment, and there are both costs of entry and adjustment costs, which preclude firms from making make zero profits in equilibrium and the real wage from equating the marginal product of labour.

On the supply side of this economy, each firm bargains with $\frac{L}{m}$ workers over wages and employment. After the bargain is settled, firms use the agreed level of employment to produce output (see Blanchard and Giavazzi, 2003, for a similar setup). On the demand side, consumers-workers, who can be either employed or unemployed, select their consumption of two types of goods to maximize their expected utility.

We start our description of this economy from consumption. Let W be individual weight. Following Cutler, Glaeser and Shapiro, 2003, assume that individual utility is given by

$$U_j = C_j + U(F_j) - hW_j \qquad [1]$$

where j is for the individual and the two consumption bundles F and C differ because only the former affects weight W. Specification [1] conveniently rules out income effects in the consumption of good F, a useful simplifying assumption given our focus on the efficiency costs of weight and obesity.

Individuals gain utility by consuming both goods, but lose utility from being overweight or obese. The value placed on weight is captured by parameter h, which in the static setup of this model reflects also the value of the future and the expected probability of living in the future[35]. Let expected individual income R be fully spent in current consumption, and assume that the prices of good C and F are equal to 1 and p respectively. Using the budget constraint in [1] we obtain

$$U_j = R_j - pF_j + U(F_j) - hW_j \qquad [2]$$

Furthermore, assume that the relationship between the consumption of good F and weight W is regulated by the production technology $W = G(F, Z)$, where Z is a vector of variables affecting weight (for instance exercise and life style). Since the map from good F to weight W reflects the information processed by the individual,

[35] Cutler and Lleras Muney (2007) use a two period model with perfectly competitive product and labour markets. By so doing they can model explicitly the discount factor and the probability of living in the second period.

limited information, possibly associated to poor education, may imply that the map G significantly differ with respect to the actual map. Using [2] into [1] we obtain

$$U_j = R_j - pG^{-1}(W_j) + U\left[(G^{-1}(W_j)\right] - hW_j \qquad [3]$$

The privately optimal choice of *F* is given by the following necessary condition

$$U'(F^P) = hG'(F^P)$$

i.e. the marginal utility of consuming more of *F* is equal to the disutility associated to the increased weight. This choice also yields the privately optimal weight W^P, and the necessary condition for such optimum can be expressed conveniently as follows

$$\Gamma(W_j^P) = 0 \qquad [4]$$

Notice that choice of *W* (or *F*) is independent of income, because of the quasi-linearity of the utility function. Therefore, $W_j^P = W^P$ and each individual selects the same weight, a convenient result for the rest of the model.

Next consider the supply side of this economy. Each consumer-worker supplies one unit of labour inelastically, so that total labour supply is *L*, and each firm produces using the following technology

$$Y_i = A(W)N_i \qquad [5]$$

where *i* is for the firm and productivity is allowed to vary with weight: if overweight or obese individuals are less productive, $A'(W) < 0$, where the prime is for the first derivative.

With an imperfectly competitive product market, the demand faced by each firm is downward sloping and given by

$$Y_i = \frac{Y}{m}\left(\frac{P_i}{P}\right)^{-\theta} \qquad [6]$$

where P_i is the product price, *P* the average price and *Y* aggregate demand or total output.

Let wages and employment in each firm be set by Nash bargaining, and assume that in the event of failure to settle the firm makes zero profit but the worker earns the reservation utility $V(u)$, where *u* is the unemployment rate. Reservation utility depends on consumption and income from unemployment, leisure and home production. The outcome of the bargain depends on the relative bargaining power of the parties. Let β be the relative power of worker. If heavier workers are discriminated, this parameter declines with weight. Let wages be E and define μ as the product market mark-up, where $\mu = \frac{1}{\theta - 1}$. Then one can shows that in equilibrium the bargained real wage is[36]

$$\frac{E}{P} = \frac{[1 + \beta(W)\mu]}{1+\mu} A(W) \qquad [7]$$

equal to the reservation wage when β =0 and to productivity when β =1. Notice also that a higher weight W can affect earnings if it reduces productivity and lowers the bargaining power β.

Using [7] in the definition of profits $\Pi_i = \left[P - \frac{E}{A(W)} \right] Y_i$ and noticing that in the symmetric equilibrium $P_i = P = 1$, we obtain that total profits are given by

$$m\Pi = [1 - \beta(W)] \frac{\mu}{1+\mu} Y \qquad [8]$$

where we drop the subscript i because employed workers and firms are homogeneous. Following Blanchard and Giavazzi, we capture product market imperfections by assuming that entry costs are nonzero and proportional to output. Let these costs per unit of output be equal to c. Then one can show that reservation utility in the long run equilibrium is given by

$$V(u) = \frac{A(W)c}{\mu(1-\beta)} \qquad [9]$$

Since V is a monotonic (decreasing) function of the unemployment rate u, the natural rate of unemployment is

$$u^* = V^{-1}\left(\frac{A(W)c}{\mu(1-\beta)}\right) \qquad [10]$$

and total profits can be re-written as

$$m\Pi = \frac{1-\beta(W)}{1+\frac{1}{\mu}} A(W)L\left[1 - V^{-1}\left(\frac{A(W)c}{\mu(1-\beta)}\right)\right] = [1-\beta(W)]\frac{\mu}{1+\mu} Y^*(W)$$

where the natural output Y^* is decreasing in W.

[36] See Blanchard and Giavazzi, 2003, for details.

Assume that the government welfare function is a weighted sum of total utility and profits, and recall that $R = \frac{N}{L}E + (1-\frac{N}{L})V$, and define total welfare Ω as

$$\Omega = LU + m\Pi \qquad [11]$$

The socially optimal choice of W is given by maximizing [11] with respect to W, which yields

$$L\Gamma(W^s) + \left\{(1-\beta)Y^{'}(W^s) - \frac{\partial\beta}{\partial W^s}Y(W^s)\right\}\frac{\mu}{1+\mu} = 0 \qquad [12]$$

The socially optimal level of weight will differ from the private optimum if:

1. there are externalities and/or the private discount factor differs from the social one. In our simple setup, this occurs if h^p, the private valuation of weight, is different from h^s, the social valuation;
2. agents are short sighted, and fail to fully recognize the implications of their consumption of F on health;
3. the wage is not equal to marginal productivity, so that firms make positive profits. Conditional on $\beta < 1$, an additional source of variation is the presence of discrimination - or $\frac{\partial\beta}{\partial W} < 0$.

Suppose that sources 1 and 2 can be ruled out. Then privately selected weight is lower or higher than the socially optimal value depending on whether the expression within braces in [12] is positive or negative. If the "discrimination" effect prevails on the productivity effect, $W^s > W^p$, and the opposite effect occurs if it is the productivity effect to dominate.

Appendix B: Details on Microsimulation Approach for Health Care Expenditures

B.1 Overview

This appendix describes a microsimulation model used to simulate the effect of trends in obesity for the age 55+ population. The model is a simplified version of a much richer model used to study pharmaceutical innovation policy at RAND (Ladkawalla et al., 2007). We essentially use the same model but shutting down its innovation module. The core of the model is a set dynamic interactions that link present health to future health. For example, next year's health states depend on today's health states, and a set of random health shocks that vary with individuals' own risk-factors — e.g., their age, health behaviors, and current disease conditions.

In a given year, say 2024, sample individuals may have diseases and/or disabilities that put them at risk of contracting new diseases and disabilities, or even dying, in 2025. We estimate a health transition model to simulate how population health will look in 2025, given existing health conditions. Finally, mortality will have shrunk the population in 2025, but the sample is "refreshed" by introducing those who were 54 in 2024, and who now age in to our target population. This forms the set of sample individuals for 2025. The same process is then repeated to obtain the population in 2026, and so on for subsequent years, until the final year of the simulation.

To measure cost and benefits across scenarios, we use life-years and medical expenditures. For expenditures, we use cost regressions estimated on micro data. The simulations are stochastic because new diseases' arrival date is random. Furthermore, we also discuss how weights are used to match population figures.We present in turn details on each of these components. First, we describe the data. We then explain how the transition model was estimated on HRS data and then adjusted for the European data. Next we discuss how costs were calculated to evaluate each scenario. Finally, we discuss how the stochastic components of the model are implemented and how we used sample weights through

B.2 Data

We use the Health and Retirement Study, a nationally representative longitudinal study of the age 50+ population as our main source of data for the U.S. We use the observed (reported) medical history of respondents as well as age and other socio-demographic characteristics (sex, race, risk factors such as obesity and smoking). The data from the Health and Retirement Study consists of longitudinal histories of disease incidence, recorded roughly every 2 years, from 1992 to 2002, along with information on baseline disease prevalence in 1992. We use the Medical Expenditure Panel Survey (MEPS) for estimate of health care costs. For Europe, we use SHARE data which was described in section 2.1

B.3 Estimation of Transition Model

We use discrete-time hazard models to model transitions across states. We consider 7 health conditions (hypertension, heart disease, stroke, cancer, diabetes, lung disease and mental illness) to which we add functional limitation (disability) and mortality. Each of these conditions is an absorbing state meaning that once a condition is diagnosed it cannot be cured. The same assumption is made for ADL limitations, the measure of disability we use. The occurrence of mortality censors observation of diagnosis for other diseases in a current year. Mortality is recorded from exit interviews and tracks closely the life-table probabilities released by the Census Bureau.

The estimation of such model is complicated by three factors. First, the report of conditions is observed at irregular intervals (on average 24 months but varying from 18 to 30) and interview delay appears related to health conditions. Second, the presence of persistent unobserved heterogeneity (frailty) could contaminate the estimation of dynamic pathways or "feedback effects" across diseases. Finally, because the HRS samples from a population of respondents aged 50+, inference is complicated by the fact that spells are left-censored: some respondents are older than 50 at baseline and suffer from health conditions whose age of onset cannot be established. We take account of all these factors in estimation which is done by maximum likelihood. Results are available upon request. The fit is assessed by simulating the health trajectories of individuals in the first wave and comparing observed and simulated outcomes 10 years later. The fit is quite satisfactory.

B.4 Adaptation to Europe

In continental Europe, we only have access to cross-sectional data on responses of the type: has the doctor ever told you which are very similar to those encountered in the HRS. Hence, the age distribution of disease prevalence is informative about transition rates. We split the 2004 cross section in two groups based on age. We simulate outcomes of the younger age group using U.S. transition parameters until they reach the age of the older age group. We then compare prevalence of various diseases and the simulated prevalence. We choose optimally baseline hazard functions such that the difference between actual and simulated prevalence becomes relatively small. This calibration approach assumes the absence of cohort effects and assumes that U.S. and European models only differ in their baseline risks.

B.5 Costs

Because the HRS does not have accurate information on total medical expenditures and total drug expenditures, we use the Medical Expenditure Panel Study (MEPS) to construct cost regressions. We regress these expenditures on the same demographics we have in the model as well as age and health condition indicators. Few differences in the definition of variables are observed. We use the

sample of age 50+ individuals in MEPS. The regressions are performed separately for male and female as well as for each type of expenditure (drug and medical).
Since we do not have total expenditure information in Europe, we use the U.S. relationships which we adjust to reflect differences in medical practices and prices using a deflator which we obtain from OECD comparisons of health expenditure per capital. Since income and health differences (quantity inputs) could explain differences in expenditure per capita we use a regression approach to filter those out. Our empirical approach is to use a panel data model from 1990-2004 across 27 OECD countries and allow for region fixed effects. Since we control for income and health measures, these fixed effects will capture unexplained expenditure differences across countries. We assume these represent price, technology and medical practice differences.

Without control, the implied price deflator is 0.457 meaning that costs are 78.3% lower in Europe. However, this is an overestimate. We first control for differences in income, which leads to a large decline in the unexplained cost difference. Adjusting for income differences, the price deflator is 0.681 which implies that cost are 36.9% lower in SHARE Europe than in the U.S. Controls for health differences do not add much. If added separately from income, the implied price deflator is lower than without controls. However, once we include both income and health controls, the price deflator is 0.656 which implies 42.2% lower average costs in Europe. Similar results are obtained from cross-sectional regressions across years or fully interacting year and country fixed effects.

B.6 Simulation

The horizon for each simulation is 2005 to 2150 by which time 2060 new entrants are all dead. We start the simulation with the HRS and SHARE 2004 samples. We adjust weights so that they match 2004 population counts provided by the United Nations' Population Program. We do this by age in order to smooth out bumps in the age distribution. Each year, the population of age 55 respondents in 2004 is added back adjusting their weights for projected demographic trends. The simulation is repeated 50 times and outcomes are averaged.

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