ISER Working Paper Series

Body weight and socio-economic determinants: quantile estimations from the British HouseholdPanel Survey

Luca Pieroni
Department of Economics Finance and Statistics
University of Perugia

Luca Salmasi
Department of Economics
University of Verona

No. 2010-41
13 December 2010

INSTITUTE FOR SOCIAL & ECONOMIC RESEARCH

www.iser.essex.ac.uk

Non-technical summary

In this work we examine the possible causes of obesity in UK. In the past years the percentrage of obese people in the UK has increased considerably, from 15% in 1993 to 24% in 2007. The increase in weight can be associated with the increase of certain types of diseases, like heart attack, high blood pressure, diabetes type II and some types of cancer. We choose to analyse UK, even if this problem concerns many other European countries, because the growth rate of overweight was fastest in the UK.

In our work we examine how different factors, like the increasing availability of fast food and take away restaurants, the price of take away food and snacks, the price of fruits and vegetables, physical activity habits and cigarettes consumption may have determined the epidemic increase of the body weight. Because these effects could be different for people with different weight levels, we employ a method of analysis that is able to distinguish the effects for the different weight levels.

The results of our analysis are used to determine how different health behaviours may affect people's body weight, and to give an estimate of possible effects of policy interventions such as a "fat tax" on unhealthy food or a "thin subsidy" on healthy food. We find that in presence of a 20% cut to the price of fruits and vegetables an obese man could expect a weight reduction of 0.33 kg per year, while for an obese woman this reduction would be of approximately 0.5 kg per year.

We also find a negative relationship between cigarettes consumption and body weight, which can be related to a change in ex-smokers' metabolic rates. However, our findings suggest that, while stopping to smoke leads to a moderate weight gain among normal weight adults, the effects on obese men are quite small and zero for women. From a policy perspective, the decrease in cigarettes consumption associated with the recent anti-smoking policies in the UK and generally favoured by society, should not lead to an important increase in obesity.

Body weight and socio-economic determinants: quantile estimations from the British Household Panel Survey

Pieroni L.*, Salmasi L.**

*University of Perugia (Italy) and University of the West of England (UK)

**University of Verona (Italy)

Corresponding author: Pieroni L., Department of Economics, Finance and Statistics,

Via Pascoli 20, 06123 Perugia, Italy. E-mail: lpieroni@unipg.it

Abstract

This work examines the socio-economic determinants of body weight in UK by means of two recent waves from the British Household Panel Survey. Our results support some findings in the literature, but also point to new conclusions and show that quantile regression estimates are quite different from OLS ones. Among obese people, our results reveal that they are less so as male that do not spend extra-time at work or female increasing physical activity. Furthermore, smoking cessation may lead to moderate effects on weight increases only for underweight or normal-weight subjects but are not significant for obese ones.

Keywords: Body Mass Index, Overweight and Obesity, Quantile regression, Elasticity
JEL classification: I10, I12, I18

Acknowledgements

“This paper was partly based on work carried out during a visiting of Luca Salmasi to the European Centre for Analisys in the Social Sciences (ECASS) at the Institute for Social and Economic Research, University of Essex and supported by the Access to Research Infrastractures action under the EU Improving Human Potential Programme.”
Data from the British Household Panel Survey (BHPS) and the Expenditure Food Survey (EFS) were supplied by the UK Data Archive. Neither the original collectors of the data nor the archive bear any responsibility for the analysis or interpretations presented here.

1 Introduction

Empirical studies of the causes and effects of overweight and obesity have proliferated in the last decade (see Ball and Crawford, 2005, for an extensive survey). These studies have used the body mass index (BMI) as a widely available self-reporting measure of body weight. A consensus is slowly emerging on this topic although a number of aspects remain unresolved. For instance, surveys of the literature are beginning to highlight the importance of the socio-economic determinants of overweight across a large group of measures, but the role of some variables (e.g., relative prices of food) remains unclear (Rosin, 2008). Two key reasons for the lack of greater consensus of the obesity epidemic are the inability to measure the unknown genetic causes associated with individual body weight, and the difficulty of quantifying imbalances in energy intake and expenditure, the nature of these imbalances, and their social, cultural and environmental determinants. In addition, the obesity level is an important issue from a policy perspective. Actually, while obesity control has become an increasingly urgent public health priority for national governments and international organisations, the effectiveness of some preventive efforts of these policies, based on taxation or subsidies, is not yet completely clear[1].

This paper examines whether economic and social determinants significantly affect body weight in the United Kingdom. The obesity issue in the UK motivates our analysis because, among western European countries, it records the highest levels of obese and overweight people and, to the best of our knowledge, no other works have investigated the socio-economic determinants responsible for the increase in obesity among adults.

This evidence leads to an important policy question. Are there differing determinants of obesity in highly overweight individuals compared with lower BMI ones? If the answer to this question were affirmative, our findings would have significant implications for overweight control policy-making. That is, identification of some key causes of obesity could then be qualified in terms of their sensitivity to obesity levels.

Our research is related to a number of empirical papers testing overweight as the result of several socio-economic changes which have altered people's lifestyle choices. In particular, the framework of our work is close to that of Chou et al. (2004) and Rashad et al. (2006) who examined the consequences of changes in relative prices

[1] For a recent systematic review of the effect of fiscal policies on obesity, see Thow et al. (2010).

and in the density of different types of restaurants on obesity, as well as the influence of cigarette consumption. Like Gruber and Frakes (2006) and Fang et al. (2009), we emphasise the role of smoking consumption changes in affecting body weight by exploiting the estimates of the entire BMI distribution in shedding light on its ambiguous aggregate effect. We also refer to the cumulative effects of technological changes, which demonstrate shifts over time in employment from agricultural and manufacturing to services and sedentary jobs, but which are also responsible for reductions in calorie expenditure in housework and for the lower cost of calories due to innovations in agriculture (Philipson and Posner, 1999; Lakdawalla and Philipson, 2009).

We contribute to this debate by focusing on estimates of the entire distribution of BMI, because it is probable that individuals respond differently to the factors which lead to obesity. From an econometric point of view, we use quantile regressions to determine whether the existing level of obesity affects how the determinants of overweight come into play. We proceed with this econometric technique, keeping our work close in spirit to that of other papers in the literature on obesity, including works by Kamhon and Wei-Der (2004), Quintana-Domeque (2005), Classen (2005), Atella et al. (2008) and Auld and Powell (2009).

Our results regarding the significant socio-economic determinants of body weight are supported by findings in this literature; others reveal sensitivity to BMI distribution. In some cases, quantile regression results are quite different from ordinary least squares (OLS) results, suggesting that some of the obesity control policies, which are based on OLS results, should be reconsidered with respect to the ''distance" between overweight and normal or underweight individuals. Our findings are also generally consistent for differences by gender estimates.

The rest of the paper is structured as follows. Section 2 discusses the background of our analysis, and section 3 describes the data used and presents the theoretical assumption under which estimates should be carried out. Section 4 specifies the empirical model to test which socio-economic determinants affect body weight. Sections 5 and 6 present OLS and quantile regression results and discuss some important policy implications according to estimated elasticities. Section 7 provides some concluding remarks.

2 Background: body weight and socio-economic variables

In the last few decades, obesity has become an important risk factor for a number of severe and chronic diseases which constitute the main causes of death, including heart disease, stroke, and some types of cancer. It also contributes to other serious life-shortening conditions such as Type 2 diabetes. Data from the United States show that the prevalence of overweight and obesity began to increase around the mid-1980s and has continued to increase dramatically. The increase in obesity in the UK is similar to that of the United States although it starts from a lower level (Brunello et al., 2009). A health report by the European Communities (2005) emphasises the fact that the percentages of obese and overweight adults are very different among European countries. The United Kingdom, Germany and Hungary are the countries with the highest percentages of obese people, and Norway, Italy and Austria are those with the lowest. An interesting research question is therefore: why is obesity much higher in the UK than in other European countries, and which - if they are significant - are the socio-economic causes that contribute to determining this result?

Figure 1 shows the trends of obesity in aggregate for all adult men and women, and indicates that obesity has constantly risen over the last fifteen years (15% since 1993), with similar trends for both men and women. This persistent growth suggests that, at least, some causes may have become structural in determining obesity in the UK.

Figure 1: Percentage of obesity in UK by gender: 1993 - 2007

The consequences of adult overweight are also growing in the UK. The National Audit Office (NAO, 1998) stresses that 6% of total deaths in the UK can be associated with obesity, and increased to 6.8% in a few years according to a research conducted by a House of Commons Select Committee (2004). In addition, the number of Finished Consultant Episodes (FCEs), providing a primary diagnoses of obesity, has increased consistently from 1996 to 2006. As a consequence, the burden associated with obesity on the National Health Service (NHS) was estimated to have increased between 1998-2006 from 1.5% to 2.6% of total health expenditure. More recently, estimates by the Government Office for Science (2007) forecast that the NHS cost attributable to the obesity epidemic may rise to 5.3 billion sterling by 2025[2].

In contrast with the data reported for the United States and Italy, the increase in body weight in the UK does not seem to be associated with a significantly increasing pattern in calorie consumption[3]. Figure 2 shows the *per capita* calorie consumption, subdivided for home and eating out on an annual basis from 1995 to 2007. These patterns are stable over that period, showing a slight decrease in the last period of the sample. In Figure 3 is shown the path of food prices with respect to the aggregate price index: changes in relative food prices have decreased constantly each year by 1%, making food (calorie) consumption potentially more convenient. This is in line with the findings of Lakdawalla and Philipson (2009) in the United States who, while reporting a reduction in the price of food, also noted that the market demand for food did not seem to increase[4]. However, the determinants of obesity may not affect individuals equally.

This argumentation is partly supported by addictive behaviour in gaining calories, which, summarises the effects of different (hidden) individual determinant behaviours (Cawley, 1999). That is, overweight individuals may ‘’feed on themselves”, so as obesity issues tend to become more entrenched in already obese individuals[5]. This implies that an increase in the relative demand for food by overweight people, but not necessarily an increase in aggregate food demand, may explain why obesity is increasing.

As will be argued below, if we rely on the energy accounting framework, in which

[2] These estimates are discussed in the report ”Tackling Obesities: Future Choices”, 2007.

[3] Bleich et al. (2007) and Pieroni et al. (2010), respectively.

[4] Using historical data Costa and Steckel (1997) show frequently coinciding declines in calories and prices, and growth in weight. For example, the increasingly larger portions at fastfood outlets and restaurants should also be interpreted as responses to the growing food supply and consistent with the prediction of falling relative food prices.

[5] Blanchflower et al. (2009) provide cross-sectional evidence for Germany that overweight perceptions and dieting are influenced by a person’s relative BMI.

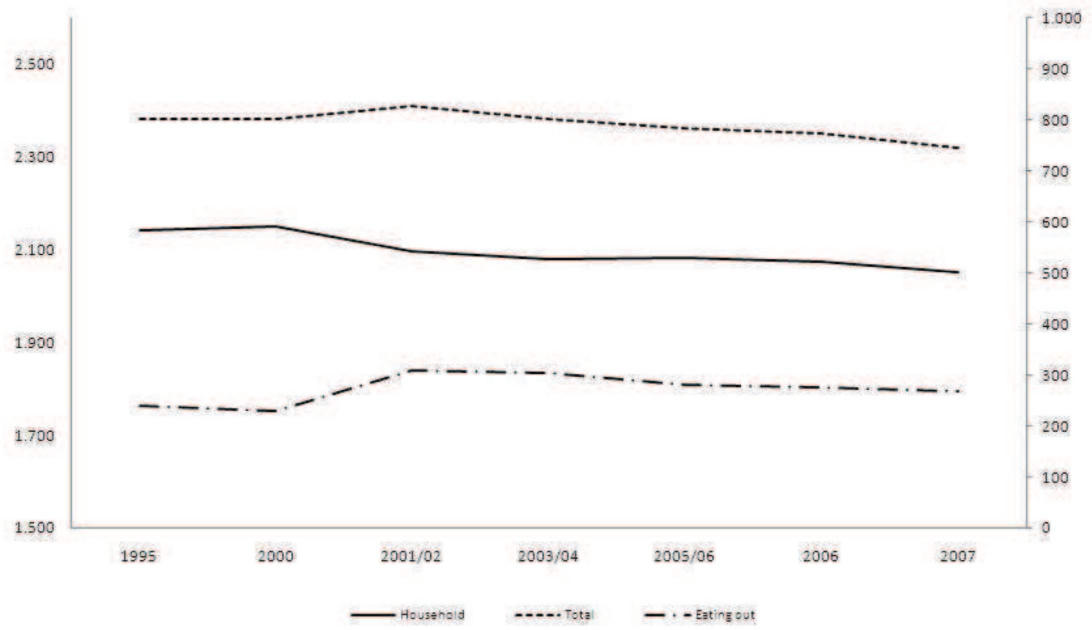

Figure 2: Consumption of calories in UK: 1995 - 2007. On the right scale: household and total calories; on the left scale: eating-out calories

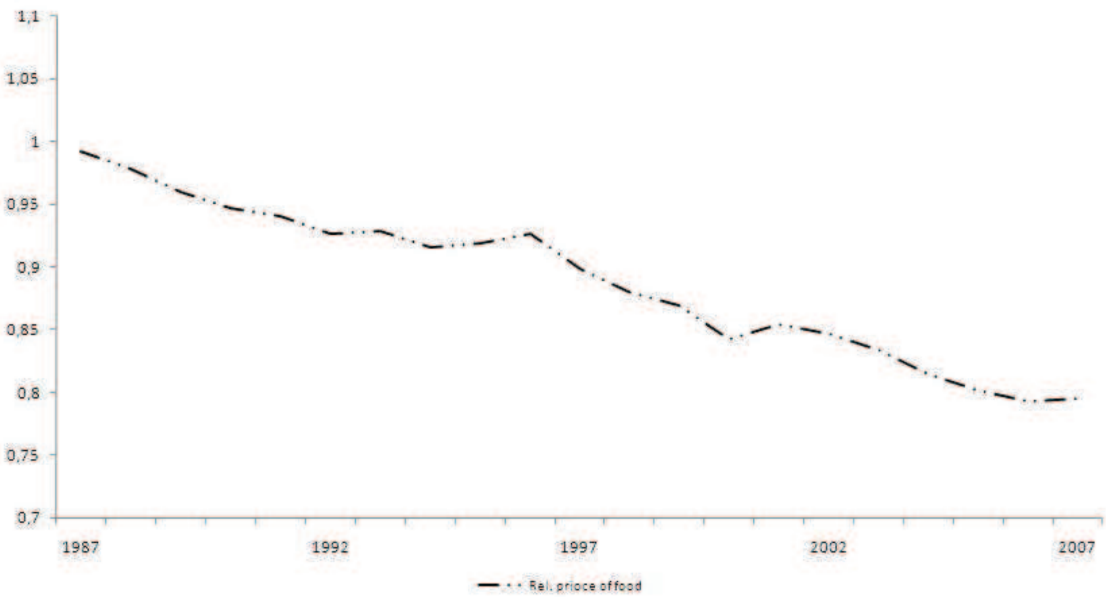

Figure 3: Changes in UK relative food price: 1987 - 2007

body weight increases when more calories are taken in than are consumed, lack of physical activity seems to be a supplementary candidate in explaining the dimension of weight in the UK. Since our aim is to explain why a given individual is overweight in a hypothetical time-constant framework, which implies that the strenuousness of work both at home and in the market are constant, the cross-individual variability of the cost of physical activity responds to a direct measure of the propensity (or frequency) of participating in leisure-based exercises, such as jogging or gymnastics or, more in general, of substituting extra hours of work with an increase in physical exercise.

If we look at the UK, the percentages of both men and women undertaking physical exercise has increased constantly and considerably over the last ten years[6], but even in 2007, one-third of the population had not kept up with the Government guidelines for physical exercise. Also in this context, the different roles played by men and women in the family and society seems to be a constraint for physical exercise and to affect gender body weight non-equally. The main reasons for not taking exercise, as they emerged from the survey, were work commitments and lack of leisure time for men, and exactly the opposite for women (NHS, 2009).

Another explanation for increasing body weight was given by Chou et al. (2004), who argued that it was the result of several economic changes which have modified people's lifestyle choices. In particular, the main changes proposed to affect weight are: i) changes in relative prices, favouring meals in fast-food and full-service restaurants, had important effects on overweight; ii) the increasing female work participation rate, which has reduced the amount of time spent on housework and cooking meals with basic ingredients, has determined growing weight, even when the relative prices of eating at home have declined. This theoretical framework assumed that traditional meals are less dense in calories, and that the demand for convenience foods and unhealthy fast food was a response to the increasing value of women's household time; iii) increases in the relative price of cigarettes - as well as the effects of legislation (clean indoor air laws), which have reduced smoking - may have contributed to increasing average weight, because smokers may have higher metabolic rates than non-smokers[7].

However, although it could be argued that the rising cost of time based on female labour force participation and the link with food prices and weight may not be a current viable option when measured in terms of time correlations (Goldin and Katz, 2002), there are fundamental reasons (see later) for expecting body fat to be sensitive to these socio-economic circumstances in the UK. We will return to this discussion by presenting an identifying extension of body weight determinants in a more general, although static, framework than that of Chou et al. (2004).

[6]From 32% in 1997 to 40% in 2007 for men and from 17% to 21% for women.

[7]In the medical literature (Grunberg, 1985; Klesges et al., 1989; French and Jeffery, 1995), changes in dietary intake, physical activity and metabolic rate are some of the proposed mechanism through which body weight is affected by smoking.

3 Data and theoretical remarks

The dataset used in this paper was extracted from the British Household Panel Survey (BHPS), a multi-purpose survey which reports information at both household and individual levels for a representative panel of the UK population. The original sample was composed of 5,500 households and 10,300 individuals, drawn from 250 areas of England and was subsequently enlarged to include Scotland and Wales in 1999 and Northern Ireland in 2002. The dataset has 18 waves: the first survey was conducted in 1980 but, for our purposes, we use a sample of two waves, the 14^{th} and 16^{th} waves, conducted respectively in 2004 and 2006, because two anthropomorphic characteristics of individuals (height and weight) were also collected for those particular waves. We then selected a balanced panel database on individuals from the two waves, and derived the BMI for a representative sample of the UK population (13,230 individuals for each year)[8].

To test the influence of socio-economic determinants of obesity growth in the UK, we applied the energy accounting approach, an appropriate multivariate framework to model body weight as a function of individual characteristics (Cutler et al. 2003; Michaud et al., 2007). This theory is useful because it is based on the excess of calories between energy intake and expenditure responsible for increases in individual weight at a given point in time over the life-cycle.

Note that, this framework should find its natural specification in a dynamic model in which calorie imbalance is adjusted over time, varying with the age effect. Unfortunately, as the BHPS dataset used is a short panel, we are not able to follow adequately individuals over time. An alternative approach involves the use of this panel as pooled data. It is assumed that the variables responsible for the relationship tested, e.g. BMI and socio-economic indicators, are in steady-state, so that we can give a cumulative interpretation of the energy-accounting equations . We follow Chou et al. (2004) in modelling determinants of body weight, and the underlying relationships are theoretically consistent if we are able to believe, or test, that the static reduced-form model, specified below, reflects the steady-state equilibrium conditions[9].

In order fully to exploit information from the two BHPS waves, we account for

[8] BMI is a measure of body fat largely used in the social field because it is often recorded within socio-economic surveys. Although it has been shown that the self-reported weight generally used to estimate BMI produces measurement errors in young and adult people, the data obtained with adjusted BMI are very close to those obtained with self-reported indexes (Zagorsky, 2005; Burkhauser and Cawley, 2006).

[9] Within the context of Becker's (1965) household production model, we can also of think BMI as a health outcome, which is the result of choices made in a health production model (Lakdawalla and Philipson, 2009).

short cyclical effects on variables by including a time dummy variable. Its inclusions is useful in identifying the unobserved time heterogeneity of individuals born in different periods. This implies that the error terms from both periods are constants and have the usual assumption for the estimates.

There should be another source of misspecification linked with the steady state BMI's respondents. This issue is associated with the heterogeneous responses of individuals on health behaviours, and in particular, on the choice of the optimal weight over the life-cycle to the long-term imbalances in energy intake and expenditure. By including the age variable (or its polynomial specification) in a reduced form of the model, we could therefore be able to control for the body weight response of a specific age but anyone ensures that this behaviour will be stable for some time except for older people that are known to be unaffected by past and current shocks. These effects - if empirically important - may affect the error structure of the reduced-form model[10].

A relevant sensitivity analysis to verify the equilibrium assumption for our data is, therefore, to compare the estimated parameters of the benchmark model with those obtained from a sub-sample which is assumed to be less age-sensitive. The cumulative interpretation of the energy-accounting equations is consistent with the view that body weight has stabilized in the older population examined (e.g. in those over 50). If negligible differences are found between BMI estimates obtained from the full sample and those from older people, then this should mean that the results of the complete sample have a high degree of external validity in explaining the determinants of obesity in the UK.

4 The empirical model

Chou et al. (2004) list a number of hypotheses which link socio-economic determinants to body weight. Referring to their discussion and the literature they cite, we postulate that the following equation holds:

$$BMI_{i,j} = f\left(S_{i,j}, Z_j, D_{i,j}, R_j\right) \tag{1}$$

where $S_{i,j}$ denotes individual-level influences on body weight, Z_j the influences of regional variables, $D_{i,j}$ is a vector of socio-economic and demographic variables which

[10]As a by-product, the age variable can correct biases in self-reported measures of BMI, which tends to increase with age, particularly for height (Burkhauser and Cawley, 2006).

control for body weight, and R_j the influence of specific macro-regional variables.

The vector of individual variables $S_{i,j}$ contains as covariates the number of cigarettes smoked per day and whether or not the mother works. Although an inverse relationship between smoking and body weight has been documented in the clinical and economic literature, the effect of cigarette smoking on obesity remains inconclusive. Focusing on the economic literature, Chou et al. (2004), Rashad and Grossman (2004) and Baum (2009) have found that the decline in smoking rate by higher taxes or prices are associated with higher rates of obesity. Consistent with this finding, Flegal (2007) suggests that a decline in smoking increases obesity but these effects are estimated to be small. In contrast, Gruber and Frakes (2006) have found an opposite effect of smoking taxes on obesity using the same data. The evidence of this unexpected relationship was further supported by Cawley et al. (2004) when females groups were investigated. In addition, Nonnemaker et al. (2009) found no evidence between higher smoking taxes and obesity rates. With respect to this literature, the use of the observed consumption, instead of cigarette taxes or prices in assessing directly its effect on individual weight, may avoid issues associated with endogeneity. As discussed by Gruber and Frakes (2006), cigarette prices or taxes are generally recorded at regional or state level, so changes may also be driven by other market factors which affect both the rates of smoking and eating.

It has been widely argued that increased body weight is a response to expanded labour market opportunities for women which, by increasing the value of household time, have also increased the demand for prepared food. Although several studies have rejected this hypothesis (Cutler et al, 2003; Loureiro and Nayga, 2004), changes in the relative prices of prepared meals under increasing demand may indirectly be responsible for increased body weight. Consumption of meals cooked at home requires time to be spent on them, although there is a positive externality effect obtained by eating less energy-dense food. Hence, the full price of a meal at home should reflect the value of the time used to cook it, as well as the monetary price of the food eaten. Under the hypothesis that, in a post-modern society, the ''shadow" marginal cost of an hour spent cooking at home is greater than the opportunity cost of an hour at work, the demand for prepared food increases as women, particularly mothers, tend to participate in work. Thus, average body weight is expected to increase as the female work participation rate rises.

In his economic analysis of obesity, Philipson (2001) also emphasises the role of innovations which economise on time previously allocated to the non-market sector. One such innovation, largely tested as a determinant in the obesity literature, concerns the growing availability of fast food and full-service restaurants. The spread of fast food is linked with an increase in less expensive food because, the greater food supply reduces the price of fast food with respect to other foods. In addition, the content of this food, more energy-dense, may corroborate the hypothesis of increases in body weight (Schlosser, 2001; Drewnowski, 2003). With respect to Auld and Powell (2009) and Chou et al. (2004), our data do not use separately the prices of fast food at UK regional level to test the hypothesis that reductions in fast-food restaurant prices induce a substitution towards food consumption with higher calories. In the same way, we maintain the argument by including an index measuring the price of fruit and vegetables at regional level as a proxy behaviour of less energy-dense food, i.e. more healthy food, so that we can examine whether price increases have significant effects on BMI growth. In these and all subsequent models, we also include the regional price of take-away meals and snacks as a control variable in Z_j. Meeting household needs and work constraints, the great increase in take-away meals (and snacks) in the UK may have increased the proportion of energy-dense food in the diet and, on average, overweight. As argued in this literature, we are interested in testing this hypothesis in women[11].

In addition, the level of overweight has been found to be linked with the great increase in the *per capita* number of restaurants and fast-food outlets (see also Rashad et al., 2006). It is known from studies in the United States that such outlets are located in areas where consumers put a relatively high price on their time. But this evidence seems to be also confirmed in specific groups of society and by gender. Currie et al. (2010) have found that, among pregnant women, the residence distance from fast food restaurants reduce the probability of gaining weight over 20 Kg. In our empirical analysis, we include the density of restaurant food supply, assumed to be positively correlated with the higher marginal cost of time for lunch or breaks while the likely non-linear influence in increasing body weight is captured by the square of the same variable.

Table 1 lists all demographic variables $D_{i,j}$ as well as the variables included in the estimates. BMI is assumed to depend on (non-linear) age, race, marital status,

[11] The literature on food energy density did not confirm the concept that a decrease in the price of energy-dense food tends to increase total calorie consumption at aggregate level: if energy-dense foods become relatively cheaper, we may observe offsetting decreases in the consumption of less dense foods, so that total calories would change or even decrease (Auld and Powell, 2009).

education, and income. Because this weight indicator is essentially used to measure obesity, individuals of a certain age, income or education may be at higher risk of being overweight. Schroeter et al. (2008) found that income changes in cross-country analyses could lead to weight gains, except in cases when all foods were inferior goods. However, the relationship between within-country income and weight may differ given the narrow and small cross-country variability of strenuousness level at work. As argued by Lakdawalla and Philipson (2009), increases in income raise weight in underweight people, but further increases may actually reduce weight in obese people. This mechanism is based on the optimal individual BMI which, in our specification, produces a positive marginal utility of BMI (BMI>0) if changes in income affect underweight people, and negative (BMI<0) if they affect overweight people. An inverted U-shaped relationship between income and weight thus emerges. However, the magnitude of the income effect may be overestimated, due to reverse causality from obesity to income, i.e., endogeneity. Higher body weight may, indeed, lead to lower wages, due to effects on productivity or employment discrimination (Cawley, 2004). Weight and income may also be negatively correlated because of unobservable personal characteristics, such as self-discipline or impulsivity (Cutler et al., 2003).

It is clear that densities of food supply and food prices are generally identified by variations due to supply, rather than demand side-shocks. In our specification, we reduce the dependence of prices and densities of food supply on demand side-shocks at regional level by comprising three regional dummy variables, including the effect of living in London, Yorkshire and the Humber and Scotland. These three regions are peculiar because, according to ''Statistics on Obesity, Physical Activity and Diet: England, February 2009", published by the NHS, and ''Obesity in Scotland: an epidemiology briefing", by the Scottish Public Health Observatory, inner and outer London are the areas with the lowest levels of obesity in the UK, while those of Yorkshire and the Humber and Scotland are the highest. In Scotland this result is true, especially for older women. However, excluding the possibility that the specific regional variables which we consider are correlated with genetic determinants, we examine therefore the socio-economic determinants of obesity in the UK net of the fact that regression disturbance terms may affect estimates.

In the following, we complement an empirical hypothesis with the suggestions of Lakdawalla and Philipson (2009) to explain why a given individual may be over-

Table 1: Data definitions and sources

Variable	Definition	Source
Job_hours	Number of hours normally worked per week, including overtime	BHPS
Phys_Activity	Dummy variable equal to one if respondents make physical activity at least once a week	BHPS
Strenuousness	Dummy variable that measures the strenousness of work in which respondents' are involved	BHPS
$Price_{F\&V}$	Price of fruits and vegetables	ONS
Price_{TA}	Price of take away and snacks	ONS
Rest/FF	Density of restaurants and fast food	ONS
Rest/FF^2	Squared density of and restaurants and fast food	ONS
N_Cigarettes	Number of cigarettes usually smoked per day	BHPS
Work_Mother	Dummy equal to one if the respondents' household mother is involved in a full time job	BHPS
Black	Dummy equal to one if respondents' ethnicity is black	BHPS
Age	Respondents' age	BHPS
Age^2	Respondents' squared age	BHPS
Net_Income	Net household income	BHPS
Net_Income^2	Squared net household income	BHPS
Couple	Dummy equal to one if respondents' marital status is couple	BHPS
Married	Dummy equal to one if respondents' marital status is married	BHPS
Divorced	Dummy equal to one if respondents' marital status is divorced	BHPS
Separated	Dummy equal to one if respondents' marital status is separated	BHPS
Widowed	Dummy equal to one if respondents' marital status is widowed	BHPS
Degree	Dummy equal to one if respondents' education is degree	BHPS
Diploma	Dummy equal to one if respondents' education is diploma	BHPS
Alevel	Dummy equal to one if respondents' education is Alevel	BHPS
Olevel	Dummy equal to one if respondents' education is Olevel	BHPS

Note: Data retrieved from British Household Panel Survey (BHPS) and Office for National Statistics (ONS)

weight. We assume that workers who spend more extra hours at their jobs are more likely to be overweight than those who do normal job hours, because they have less leisure to devote to leisure activities which, on average, are more physically demanding. This hypothesis is largely explained by the increases in sedentary job in post-modern society.

As a strenuous job is assumed to be weak and constant in developed countries and within specific jobs, we specify and estimate a model that includes as explanatory variable the number of hours normally worked per week (including overtime) and evaluate whether it causes a rise in body weight.

In Section 2, we showed that the main reasons for not exercising were not only given as extra work commitments, but also as a lack of leisure time, and that the latter was mainly suggested by women. We directly proxy physical activity by a dummy which takes value 1 when an individual exercises at least once a week and 0 otherwise, and verify the heterogeneous influence on body weight by estimating separate gender models. The (negative) dimension of the estimated coefficient of individual physical activity on weight indicates how the cost of physical activity rises. Formally, these specifications are given as:

$$BMI_{i,j,k} = f\left(W_{i,j,k}, T_{i,j,k}, D_{j,k}, R_{j,k}\right) \tag{1}$$

where $W_{i,j,k}$ is a partitioned vector which contains the number of hours worked in a normal week (including overtime) and the frequency of physical activity; $k = 1, 2$ are the equations for these separate indicators. $T_{i,j,k}$ is a dummy variable that assumes value 1 if the type of work is physically demanding, and $D_{i,k}$ and $R_{i,k}$ are vectors of already described variables. Lastly, in view of the heterogeneous gender behaviour shown above, we also estimate the influence of these equations by gender.

In order to obtain a proper reduced form, we include equation (1) in (2). Thus,

$$BMI_{i,j,k} = f\left(\widetilde{W}_{i,j,k}, T_{i,j,k}, D_{j,k}, R_{j,k}\right) \tag{2}$$

where $\widetilde{W}_{i,j,k}$ also includes $S_{i,j,k}$ and $Z_{j,k}$ for the $k = 1, 2$ equations in vector $W_{i,j,k}$, the vector of variables in (1). In the next section, we explain the use of a quantile regression framework to allow for the different effect of the same covariate at the lower tail of BMI individual distribution (underweight) and the upper one (obese).

5 Preliminary results and methods

Figure 4 shows the estimates of Epanechnikov kernel density functions for BMI distribution conditional on some covariate distributions below and above the median of our sample, and by gender. As a first result, we examine whether the underlying assumption for error terms of OLS regression is normally distributed in the covariates of interest.

Although the empirical conditional distributions for any panel in the figures are not very far from Gaussian distributions, they do not appear to meet the theoretical

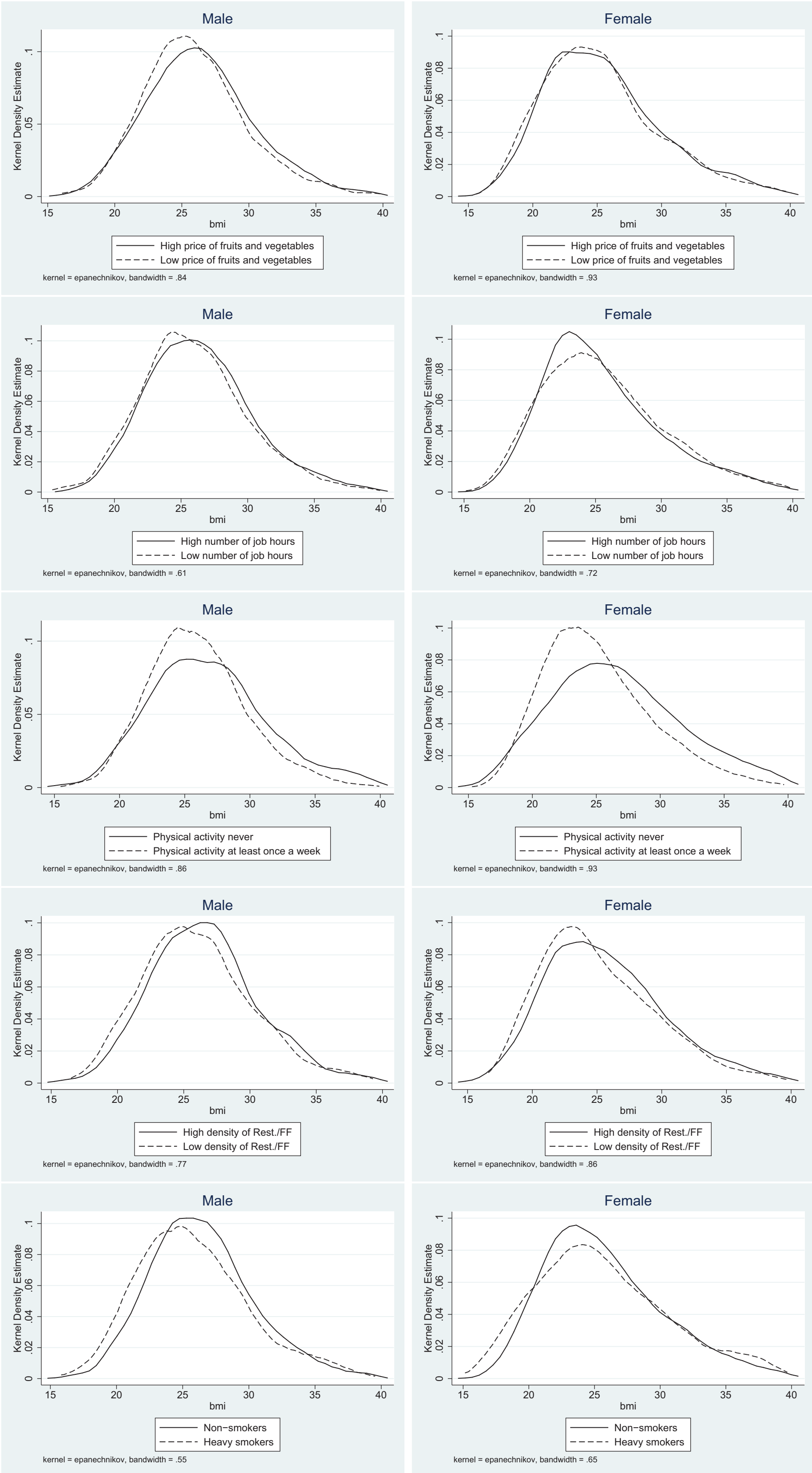

Figure 4: Kernel density estimates of BMI by gender

features required by BMI distributions and are skewed.

Table 2 characterises these kernel density estimates of conditional distributions for BMI means and medians and measures the share of obese people at the threshold (i.e., BMI $\geq$ 30). For the price of fruit and vegetables, note that the mean for men living in an area with high prices is 1.59% higher than for those living in an area with lower prices. The situation is similar for women or when the median is taken into account. In line with our expectations, the proportion of obese people is estimated to be 17% of the distribution with respect to people living in areas with higher-priced fruit and vegetables, and 14% for lower-priced ones, respectively.

Table 2: Means and medians of BMI and share of obese people according to different values of testing variables

	Male		Female		Total		Male	Female	Total
Variable	Mean	Median	Mean	Median	Mean	Median	BMI $\geq$ 30	BMI $\geq$ 30	BMI $\geq$ 30
High price of fruits & vegetables	26.41	26.15	25.54	24.85	25.93	25.54	17.51	16.94	17.27
Low price of fruits & vegetables	25.99	25.63	25.32	24.79	25.64	25.17	14.34	16.52	15.49
High number of job hours	26.42	26.11	25.46	24.62	26.02	25.54	17.38	16.19	16.88
Low number of job hours	26.02	25.63	25.61	24.94	25.76	25.23	15.72	13.69	14.73
Physical activity at least once a week	25.99	25.63	25.16	24.47	25.56	25.11	14.49	14.2	14.34
Physical activity never	26.85	26.52	26.63	26.17	26.72	26.31	22.19	24.98	23.84
High density of Restaurants and fast food	26.61	26.35	25.71	25.16	26.11	25.63	18.86	17.42	18.06
Low density of Restaurants and fast food	26.07	25.68	25.14	24.29	25.57	25.03	17.39	15.14	16.19
High number of cigarettes	25.79	26.11	25.65	25.04	25.73	25.61	17.65	17.83	17.75
Low number of cigarettes	26.46	25.38	25.73	24.85	26.07	25.12	15.08	19.89	17.41

Notes: The share of obese people has been obtained as $1 - F(BMI < 30)$, where the probability of BMI lower than the obesity threshold has been calculated from the cumulative kernel density function of BMI conditioned to testing variables.

Men working more than 30 hours a week (part-time work threshold) are more likely to have an average BMI higher than those working 30 hours or less (1.51% and 1.84% for the median). Instead, women do not reveal strong differences in the means and medians of empirical distributions. If we look at the share of obese adults, it is easy to note the fall (about 2%) for both men and women working less than 30 hours.

When we look at the variable which records physical activity habits, we observe huge differences between the BMI means and medians of people exercising at least once a week and those who never take any physical exercise: 3.31% for the mean and 3.47% for the median of men and 5.84% for the mean and 6.95% for the median of women. The quota of estimated obese people for both men and women, is the 8% higher in the case of nophysical exercise, and this result is largely consistent with our expectations.

Lower densities of restaurants and fast-food outlets are associated with decreased BMI means and medians in people resident in such areas. However, the magnitude of the effects on BMI of the density of restaurants is not as large as expected. Consistently, the shares of obese people living in areas with lower densities of restaurants and fast-food shops decrease by 1% and 2% for men and women, respectively.

In order to understand the different impact of cigarette consumption on BMI, we functionally split our sample between "non-smokers", and "heavy smokers"[12] adults. Kernel densities, plotted by gender, show that the mean and median BMI of "heavy smokers" are smaller than those of "non-smokers". Moreover, the percentage of obese "heavy smokers" is smaller than that of obese "non-smokers", for men, although this relation is not supported by the graph for women. Although based on a descriptive approach, the impact of cigarette consumption seems to be significant on underweight and normal weight women, progressively falling in influence when we consider overweight and obese women.

As BMI distributions vary according to the values of the explanatory variables, we propose a quantile regression approach to estimate the relationship between socio-economic determinants and BMI. The main empirical advantage is that the flexibility in estimating parameters at different distribution quantiles does not require any assumptions regarding error term distribution (Koenker and Bassett, 1978; Koenker and Hallock, 2001). In addition, some proxies for the socio-economic determinants which potentially affect body weight are obtained at regional level. The use of quantile regressions at least avoids including the hypothesis that individuals living in the same region are subject to similar macro-economic shocks, because there is no reason to expect that changes in BMI would be equal across individuals.

With this technique, we can carefully examine the determinants of BMI throughout the conditional distribution, with particular focus on people with the highest and lowest BMI levels, which are arguably of the greatest interest. We follow the quantile regression formulation developed by Koenker and Bassett (1978), which yields parameter estimates at multiple points in the conditional distribution of the dependent variable[13]. One particular regression quantile is the solution to

$$\min_{\beta \in R^K} \left[\sum_{i \in \left\{ BMI_i \geq \bar{x}'\beta \right\}} \theta \left| BMI_i - \bar{x}'\beta \right| + \sum_{i \in \left\{ BMI_i \leq \bar{x}'\beta \right\}} (1-\theta) \left| BMI_i - \bar{x}'\beta \right| \right] \tag{3}$$

where $\theta \in (0,1)$. The estimates are obtained by minimising the weighted sum of absolute deviations, obtaining the n^{th} quantile by appropriately weighting the residuals. The conditional quantile of BMI_i, given the vector of explanatory $\bar{x}$, is

$$Q_{BMI}(\theta|\bar{x}) = \bar{x}'\beta_\theta \tag{4}$$

[12] "Heavy smokers" are adults smoking more than 20 cigarettes per day.

[13] A helpful introduction to quantile regression appears in Koenker and Hallock (2001). Applications of this method are increasingly common see for example Hartog et al (2001) and Görg and Strobl (2002).

This formulation is analogous to OLS, $E(BMI|\bar{x}) = \bar{x}'\beta$, although OLS slope parameters are estimated only at the mean of the conditional distribution of the dependent variable. In summary, the model in equation (5) explains BMI as the vector of the covariates, with the inclusion of a year dummy variable to remove the short trends in weight outcomes and covariates and to what extent parameters β_θ change as we move across quantiles. We can then calculate the elasticities to analyse the policy implications of socio-economic determinants on body weight from the parameter estimates for each model.

6 Estimates and discussion

Table 3 lists the values of the test of equality across quantiles for the covariates included in equation (5), separately for the equation which includes job hours (hereafter, model (1)) and physical activities (model (2)). This test is valid if, at least, one estimated percentile coefficient has a different effect with respect to the others. For the equations for women, we find larger differences in quantile estimates (e.g., physical activity habits, strenuousness of job, price of fruit and vegetables, density of restaurants and fast-food shops and its square, number of cigarettes smoked, black ethnicity, net income and net income squared, age and age squared, marital status, and education). For men, these differences in covariates are less marked (effects are significant for: physical activity habits, age and age squared, marital status and education). Thus, we proceed to estimate models by quantile regressions, and use OLS estimates to compare results.

Tables 4 and 5 list the BMI estimates of models (1) and (2) for selected quantiles between the 10^{th} and 90^{th} of the distribution. The parameter estimates of quantile regressions by gender are also shown in Figures 5-8[14].

Irrespective of the model used, the estimated parameters of the (socio-demographic) control covariates are generally of the expected signs. Black respondents have a higher BMI than white respondents and, mostly for women, the coefficients vary across quantiles. Higher education is associated with a lower BMI. In addition, income effects are not significant for UK male respondents but are negative for female ones, for both OLS and quantile regressions after the median of the BMI distribu-

[14] We report the empirical BMI distribution which corresponds to some points of quantile estimates. The 10^{th} percentile of BMI distribution corresponds to a BMI of 20.65 Kg/m^2 for men and 20.72 Kg/m^2 for women, the 25^{th} to 22.62 Kg/m^2 for men and 23 Kg/m^2 for women, the 50^{th} to 25.23 Kg/m^2 for men and 25.62 Kg/m^2 for women, the 75^{th} to 28.48 Kg/m^2 for men and 28.81 for women, and the 90^{th} to 31.95 Kg/m^2 for men and 32.50 Kg/m^2 for women.

Table 3: Test for equality of coefficients across quantiles

	Models			
	(1)		**(2)**	
Variable	M	F	M	F
Job_hours	0.28	1.54	-	-
	(0.889)	(0.188)	-	-
Phys Act	-	-	28.59	17.28
	-	-	(0.000)	(0.000)
Strenuousness	1.74	1.48	1.91	2.04
	(0.138)	(0.204)	(0.107)	(0.086)
$\text{Price}_{F\&V}$	0.45	1.95	0.51	2.46
	(0.774)	(0.099)	(0.729)	(0.043)
Price_{TA}	0.22	0.69	0.61	0.83
	(0.924)	(0.597)	(0.663)	(0.507)
Rest/FF	0.94	3.26	0.81	1.71
	(0.442)	(0.011)	(0.517)	(0.145)
Rest/FF^2	1.07	3.87	1.01	2.79
	(0.369)	(0.004)	(0.411)	(0.024)
N_Cigarettes	1.28	5.61	0.61	4.75
	(0.275)	(0.002)	(0.662)	(0.000)
Work_Mother	0.29	2.14	0.82	1.07
	(0.886)	(0.073)	(0.513)	(0.369)
Black	1.04	3.47	0.18	2.71
	(0.384)	(0.007)	(0.951)	(0.029)
Age	12.17	21.03	12.34	11.93
	(0.000)	(0.000)	(0.000)	(0.000)
Age^2	14.37	18.72	17.38	12.41
	(0.000)	(0.000)	(0.000)	(0.000)
Net_Income	0.65	4.06	0.36	3.88
	(0.627)	(0.002)	(0.839)	(0.003)
Net_Income^2	0.03	2.41	0.28	2.49
	(0.999)	(0.047)	(0.888)	(0.041)
Couple	0.65	0.591	1.01	0.23
	(0.627)	(0.672)	(0.408)	(0.922)
Married	2.42	0.91	1.82	0.28
	(0.046)	(0.463)	(0.125)	(0.891)
Divorced	1.84	3.14	3.18	3.53
	(0.118)	(0.014)	(0.012)	(0.007)
Separated	1‘.14	1.11	1.22	1.23
	(0.335)	(0.355)	(0.301)	(0.296)
Widowed	2.27	2.8	3.27	1.06
	(0.059)	(0.024)	(0.010)	(0.376)
Degree	3.81	4.55	7.66	3.81
	(0.004)	(0.001)	(0.000)	(0.007)
Diploma	3.95	7.51	4.19	1.91
	(0.003)	(0.000)	(0.002)	(0.105)
Alevel	4.09	2.05	7.68	2.03
	(0.002)	(0.085)	(0.000)	(0.087)
Olevel	8.64	1.82	8.59	3.53
	(0.000)	(0.122)	(0.000)	(0.007)

Note: p-values are shown in brackets and significant levels are reported with the following notation:
Model (1) includes in the vector of the explanatory variables job hours while model (2) uses physical activity.

tion, but with very different effects. Married respondents have a BMI similar to that of couples, but greater than divorced, separated or widowed people.

Table 4: BMI OLS and quantile regressions: model (1)

	OLS		**Q 0.1**		**Q 0.25**		**Q 0.5**		**Q 0.75**		**Q 0.9**	
Variable	M	F	M	F	M	F	M	F	M	F	M	F
Job_hours	0.011***	-0.004	0.009***	0.006**	0.011***	-0.001	0.012***	-0.005	0.012***	-0.006	0.010**	-0.007
	(0.003)	(0.004)	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)	(0.007)	(0.006)	(0.011)
Strenuousness	-0.169	-0.294.	-0.049	0.074	0.013	-0.116	-0.008	-0.122	-0.228	-0.251	-0.560	-0.756**
	(0.135)	(0.172)	(0.121)	(0.078)	(0.111)	(0.135)	(0.113)	(0.151)	(0.242)	(0.185)	(0.382)	(0.323)
$\text{Price}_{F\&V}$	0.412***	0.631***	0.330***	0.329***	0.326**	0.389***	0.419***	0.514***	0.378***	0.851***	0.599***	0.937***
	(0.148)	(0.166)	(0.107)	(0.097)	(0.128)	(0.120)	(0.131)	(0.128)	(0.121)	(0.207)	(0.241)	(0.285)
Price_{TA}	-0.190	-1.077***	-0.404	-0.697**	-0.327	-0.990**	-0.423	-0.923**	-0.384	-1.07	-0.3268	-1.767**
	(0.283)	(0.309)	(0.403)	(0.273)	(0.363)	(0.419)	(0.388)	(0.371)	(0.702)	(0.344)	(0.734)	(0.870)
Rest/FF	5.175*	4.684	6.893**	4.568**	3.288	3.502	5.182**	4.099	6.111**	5.083	4.684	17.694**
	(3.129)	(3.355)	(2.909)	(1.875)	(2.408)	(2.301)	(2.488)	(3.001)	(3.115)	(4.254)	(7.208)	(8.055)
Rest/FF^2	-2.680**	-2.349*	-3.647***	-1.883**	-1.821.	-1.467	-2.547**	-1.884	-3.153**	-2.519	-2.763	-8.701**
	(1.363)	(1.418)	(1.328)	(0.821)	(1.040)	(0.978)	(1.110)	(1.306)	(1.305)	(1.700)	(2.885)	(3.433)
N_Cigarettes	-0.048***	-0.036***	-0.058***	-0.057***	-0.053***	-0.051***	-0.052***	-0.020**	-0.038***	-0.023	0.027	-0.007
	(0.009)	(0.010)	(0.007)	(0.007)	(0.006)	(0.008)	(0.007)	(0.009)	(0.011)	(0.02)	(0.018)	(0.022)
Work_Mother	0.266**	0.548***	0.177	0.287***	0.328***	0.418***	0.294**	0.644***	0.335***	0.744***	0.211	0.898***
	(0.119)	(0.147)	(0.121)	(0.078)	(0.102)	(0.137)	(0.120)	(0.162)	(0.148)	(0.164)	(0.184)	(0.326)
Black	0.690	0.584	0.809	-0.399	0.706	-0.574	0.701	0.804***	-0.054	0.322	0.501	3.983***
	(0.597)	(0.733)	(0.702)	(0.340)	(0.476)	(0.848)	(0.572)	(0.306)	(0.891)	(0.679)	(1.581)	(1.115)
Age	0.321***	0.291***	0.207***	0.178***	0.240***	0.216***	0.281***	0.250***	0.334***	0.353***	0.429***	0.446***
	(0.022)	(0.023)	(0.018)	(0.015)	(0.018)	(0.017)	(0.016)	(0.023)	(0.021)	(0.025)	(0.033)	(0.050)
Age^2	-0.003***	-0.003***	-0.002***	-0.002***	-0.002***	-0.002***	-0.003***	-0.002***	0	-0.003***	0	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Net_Income	-0.107	-1.31***	0.376	0.170	0.428	-0.724	0.158	-1.422***	-0.684	-1.239	-0.446	-2.631**
	(0.557)	(0.507)	(0.642)	(0.281)	(0.657)	(0.446)	(0.518)	(0.526)	(0.634)	(0.805)	(0.839)	(1.136)
Net_Income^2	-0.163	0.126	-0.213	-0.179	-0.162	0.189	-0.163	0.209	-0.035	0.042	-0.029	0.239
	(0.320)	(0.170)	(0.407)	(0.120)	(0.544)	(0.237)	(0.360)	(0.223)	(0.337)	(0.346)	(0.401)	(0.440)
Couple	0.483**	0.570**	0.845***	0.462.	0.751***	0.662***	0.623***	0.682***	0.411	0.673**	-0.002	0.477
	(0.233)	(0.238)	(0.184)	(0.251)	(0.190)	(0.231)	(0.189)	(0.228)	(0.278)	(0.316)	(0.552)	(0.522)
Married	0.554**	0.536**	1.219***	0.411**	1.017***	0.463**	0.806***	0.404**	0.528***	0.730**	-0.343***	0.987***
	(0.228)	(0.243)	(0.172)	(0.199)	(0.210)	(0.187)	(0.167)	(0.165)	(0.201)	(0.307)	(0.445)	(0.344)
Divorced	0.222	0.566	1.005***	-0.265	0.585.	0.253	0.739**	0.448	0.119	0.893**	-0.517	1.022*
	(0.368)	(0.350)	(0.308)	(0.268)	(0.315)	(0.239)	(0.324)	(0.346)	(0.319)	(0.431)	(0.881)	(0.605)
Separated	-0.398	0.282	0.243	0.096	-0.023	0.116	0.084	-0.169	-0.477	0.669	-1.979	1.688
	(0.492)	(0.497)	(0.561)	(0.229)	(0.387)	(0.407)	(0.436)	(0.410)	(0.459)	(0.770)	(1.544)	(1.131)
Widowed	0.684**	0.736**	1.529***	0.167	1.405***	0.361	0.898***	0.601**	0.621*	0.903***	-0.416	1.977***
	(0.333)	(0.338)	(0.389)	(0.205)	(0.297)	(0.426)	(0.276)	(0.264)	(0.341)	(0.324)	(0.575)	(0.449)
Degree	-1.177***	-1.881***	-0.786***	-0.972***	-0.667***	-1.414***	-0.855***	-1.746***	-2.104***	-2.408***	-2.229***	-2.647***
	(0.230)	(0.237)	(0.204)	(0.164)	(0.183)	(0.209)	(0.209)	(0.197)	(0.284)	(0.332)	(0.547)	(0.498)
Diploma	-0.589***	-1.138***	-0.137	-0.598***	-0.278.	-1.026***	-0.416***	-1.082***	-1.105***	-1.156***	-0.968***	-1.170***
	(0.184)	(0.191)	(0.159)	(0.107)	(0.144)	(0.203)	(0.147)	(0.178)	(0.255)	(0.250)	(0.309)	(0.341)
Alevel	-0.597**	-0.769***	-0.100	-0.571***	-0.396**	-1.060***	-0.532***	-1.025***	-1.050***	-0.820.	-1.708***	-0.375
	(0.235)	(0.262)	(0.178)	(0.108)	(0.155)	(0.246)	(0.189)	(0.202)	(0.233)	(0.429)	(0.514)	(0.538)
Olevel	-0.433**	-0.78***	0.283	-0.552***	0.109	-0.831***	-0.244	-0.692***	-0.710**	-0.859**	-1.580***	-0.634
	(0.205)	(0.218)	(0.176)	(0.127)	(0.167)	(0.163)	(0.176)	(0.185)	(0.217)	(0.406)	(0.431)	(0.391)
D_{2004}	-0.805***	-1.332***	-0.634***	-0.370***	-0.644***	-0.785***	-0.862***	-1.153***	-0.791***	-1.793***	-1.210***	-2.182***
	(0.187)	(0.206)	(0.181)	(0.143)	(0.192)	(0.176)	(0.196)	(0.245)	(0.216)	(0.329)	(0.347)	(0.592)
Cons.	10.692	108.293***	40.178	78.087**	33.388	112.956*	39.375	97.073**	39.346	91.655	-63.563	170.719
	(32.749)	(35.488)	(52.891)	(38.538)	(46.623)	(51.289)	(48.307)	(44.591)	(44.860)	(91.005)	(87.869)	(105.107)
R^2	0.09	0.07	0.09	0.04	0.07	0.04	0.06	0.05	0.04	0.05	0.03	0.04

*Note: Standard errors are shown in round brackets and significant levels are reported with the following notation: p-value *** $\leq$ 0.01, ** $\leq$ 0.05, * $\leq$ 0.1. The description of variables are reported in Table 1.*

One first result of our estimates was that we found an increase in body weight in men, significantly affected by increasing job hours per week and evenly distributed across quantiles (Table 4). Instead, women's BMI were not related to job hours except for those at 10^{th} percentile. We conclude that working men gain weight through longer working days, irrespective of whether OLS or quantile regressions are used. Comparing these results with the specification estimated directly by including the frequency of physical activity (Table 5), we find significant effects for higher quantiles with respect to the median value of BMI distribution.

Table 5: BMI OLS and quantile regressions: model (2)

	OLS		Q 0.1		Q 0.25		Q 0.5		Q 0.75		Q 0.9	
Variable	M	F	M	F	M	F	M	F	M	F	M	F
Phys Act	-0.646***	-1.124***	-0.009	-0.211**	-0.139	-0.546***	-0.486***	-0.844***	-0.929***	-1.386***	-1.444***	-2.233***
	(0.112)	(0.118)	(0.127)	(0.093)	(0.093)	(0.047)	(0.119)	(0.103)	(0.119)	(0.188)	(0.233)	(0.222)
Strenuousness	-0.076	-0.298.	0.05	0.082	0.109	-0.078	0.147	-0.23	-0.133	-0.188	-0.17	-0.549
	(0.132)	(0.169)	(0.115)	(0.119)	(0.107)	(0.182)	(0.117)	(0.212)	(0.141)	(0.18)	(0.268)	(0.381)
$\text{Price}_{F\&V}$	0.434***	0.609***	0.36***	0.302**	0.301**	0.444***	0.437***	0.409**	0.421**	0.959***	0.598**	0.721**
	(0.147)	(0.165)	(0.138)	(0.127)	(0.123)	(0.139)	(0.142)	(0.169)	(0.179)	(0.273)	(0.299)	(0.299)
Price_{TA}	-0.282	-1.15***	-0.643*	-0.726**	-0.256	-1.208**	-0.414	-1.057**	-0.553	-0.913	0.191	-1.734*
	(0.28)	(0.307)	(0.363)	(0.358)	(0.352)	(0.477)	(0.464)	(0.468)	(0.567)	(0.775)	(0.822)	(0.959)
Rest/FF	5.434*	5.619*	6.569**	5.056	3.569	3.062	5.295**	3.717	6.459**	5.228*	4.604	15.215*
	(3.101)	(3.323)	(2.944)	(3.22)	(2.294)	(3.442)	(2.508)	(2.467)	(3.133)	(2.697)	(5.567)	(6.228)
Rest/FF^2	-2.810**	-2.694*	-3.524**	-2.118	-1.975**	-1.364	-2.619**	-1.669*	-3.341***	-2.591**	-2.593	-7.582***
	(1.348)	(1.403)	(1.377)	(1.355)	(0.980)	(1.428)	(1.102)	(1.007)	(1.294)	(1.116)	(2.538)	(2.564)
N_Cigarettes	-0.053***	-0.046***	-0.059***	-0.058***	-0.054***	-0.054***	-0.058***	-0.029***	-0.048***	-0.037***	-0.039**	-0.026
	(0.009)	(0.010)	(0.006)	(0.005)	(0.006)	(0.007)	(0.007)	(0.007)	(0.010)	(0.011)	(0.015)	(0.022)
Work_Mother	0.238**	0.377***	0.147	0.328***	0.304***	0.360***	0.299***	0.494***	0.282*	0.542***	0.206	0.338*
	(0.118)	(0.118)	(0.123)	(0.089)	(0.085)	(0.087)	(0.101)	(0.098)	(0.153)	(0.142)	(0.211)	(0.196)
Black	0.649	0.545	0.434	-0.408	0.839*	-0.402	0.508	0.782**	0.437	0.523	0.167	4.098***
	(0.583)	(0.744)	(0.799)	(0.413)	(0.497)	(0.817)	(0.499)	(0.386)	(0.619)	(0.762)	(1.289)	(1.153)
Age	0.322***	0.299***	0.223***	0.182***	0.245***	0.222***	0.282***	0.262***	0.340***	0.362***	0.419***	0.439***
	(0.022)	(0.023)	(0.018)	(0.017)	(0.019)	(0.016)	(0.017)	(0.020)	(0.020)	(0.023)	(0.031)	(0.055)
Age^2	-0.003***	-0.003***	-0.002***	-0.002***	-0.002***	-0.002***	-0.003***	-0.002***	-0.003***	-0.003***	-0.004***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Net_Income	0.514	-1.221**	0.866	0.375	0.831	-0.738.	0.741	-1.46***	0.331	-1.716**	-0.422	-2.306***
	(0.552)	(0.499)	(0.666)	(0.272)	(0.578)	(0.434)	(0.571)	(0.466)	(0.812)	(0.837)	(1.131)	(0.767)
Net_Income^2	-0.405	0.123	-0.460	-0.230	-0.255	0.204	-0.393	0.231	-0.512	0.381	-0.009	0.214
	(0.319)	(0.179)	(0.438)	(0.187)	(0.439)	(0.218)	(0.323)	(0.247)	(0.570)	(0.489)	(0.571)	(0.234)
Couple	0.517**	0.457.	0.921***	0.442**	0.823***	0.574***	0.679***	0.569***	0.399*	0.391	0.322	0.221
	(0.232)	(0.235)	(0.192)	(0.221)	(0.158)	(0.113)	(0.200)	(0.147)	(0.240)	(0.239)	(0.453)	(0.485)
Married	0.604***	0.425*	1.288***	0.432**	1.089***	0.383**	0.890***	0.344	0.457**	0.535**	0.051	0.695
	(0.226)	(0.240)	(0.158)	(0.180)	(0.162)	(0.182)	(0.155)	(0.224)	(0.214)	(0.244)	(0.335)	(0.463)
Divorced	0.271	0.456	1.046***	-0.190	0.690**	0.157	0.746***	0.412	0.011	0.687*	0.036	1.020*
	(0.366)	(0.344)	(0.244)	(0.216)	(0.272)	(0.334)	(0.282)	(0.268)	(0.316)	(0.366)	(0.699)	(0.600)
Separated	-0.387	0.163	0.154	0.172	0.084	0.090	0.202	-0.139	-0.493	0.845	-1.546	0.833
	(0.493)	(0.490)	(0.486)	(0.380)	(0.369)	(0.456)	(0.649)	(0.581)	(0.380)	(0.578)	(1.374)	(0.816)
Widowed	0.796**	0.648.	1.557***	0.225	1.530***	0.295	0.967***	0.540	0.725.	0.680**	0.190	1.614***
	(0.331)	(0.332)	(0.355)	(0.265)	(0.271)	(0.239)	(0.311)	(0.415)	(0.384)	(0.326)	(0.443)	(0.607)
Degree	-1.107***	-1.775***	-0.702***	-0.923***	-0.565***	-1.239***	-0.877***	-1.713***	-1.101***	-2.164***	-2.235***	-2.614***
	(0.228)	(0.233)	(0.177)	(0.229)	(0.183)	(0.158)	(0.188)	(0.176)	(0.229)	(0.217)	(0.361)	(0.437)
Diploma	-0.526***	-1.065***	-0.108	-0.572***	-0.160	-0.904***	-0.358***	-1.046***	-0.579***	-1.137***	-1.157***	-1.031***
	(0.183)	(0.189)	(0.133)	(0.125)	(0.146)	(0.141)	(0.129)	(0.124)	(0.210)	(0.237)	(0.246)	(0.348)
Alevel	-0.581**	-0.700***	-0.099	-0.548***	-0.303*	-0.930***	-0.587***	-1.043***	-1.070***	-0.761**	-1.309***	-0.290
	(0.233)	(0.259)	(0.156)	(0.165)	(0.166)	(0.198)	(0.187)	(0.149)	(0.233)	(0.337)	(0.385)	(0.782)
Olevel	-0.412**	-0.739***	0.326**	-0.503***	0.164	-0.732***	-0.254*	-0.687***	-0.604***	-1.000***	-1.488***	-0.595*
	(0.204)	(0.216)	(0.152)	(0.179)	(0.139)	(0.220)	(0.146)	(0.235)	(0.210)	(0.284)	(0.296)	(0.342)
D_{2004}	-0.860***	-1.364***	-0.731***	-0.372**	-0.623***	-0.949***	-0.846***	-1.113***	-0.882***	-1.893***	-1.346***	-1.868***
	(0.186)	(0.205)	(0.197)	(0.150)	(0.193)	(0.196)	(0.219)	(0.279)	(0.275)	(0.321)	(0.394)	(0.504)
Cons.	21.179	119.175***	68.399	83.632	26.112	137.320**	37.310	122.377**	58.419	64.796	-45.313	185.415
	(32.350)	(35.188)	(47.490)	(50.991)	(45.333)	(58.274)	(58.865)	(58.542)	(72.175)	(105.989)	(109.700)	(129.646)
R^2	0.09	0.08	0.09	0.04	0.07	0.05	0.06	0.05	0.04	0.06	0.03	0.06

*Note: Standard errors are shown in round brackets and significant levels are reported with the following notation: p-value *** $\leq$ 0.01, ** $\leq$ 0.05, * $\leq$ 0.1. The description of variables are reported in Table 1.*

Below, if not specified, the estimated covariate coefficients should be considered as similar effects through models (1) and (2). The price of fruit and vegetables is responsible for changes in BMI, with a larger effect on women. Although quantile estimates are very close to OLS up to the median, they become larger when estimated for overweight people. Gender differences are found in explaining food price effects of take-aways and restaurants on BMI. Under the hypothesis of a greater propensity to supply more energy-dense food in take-aways and restaurants, for the women group we note the significant and largely negative impact on body weight at the

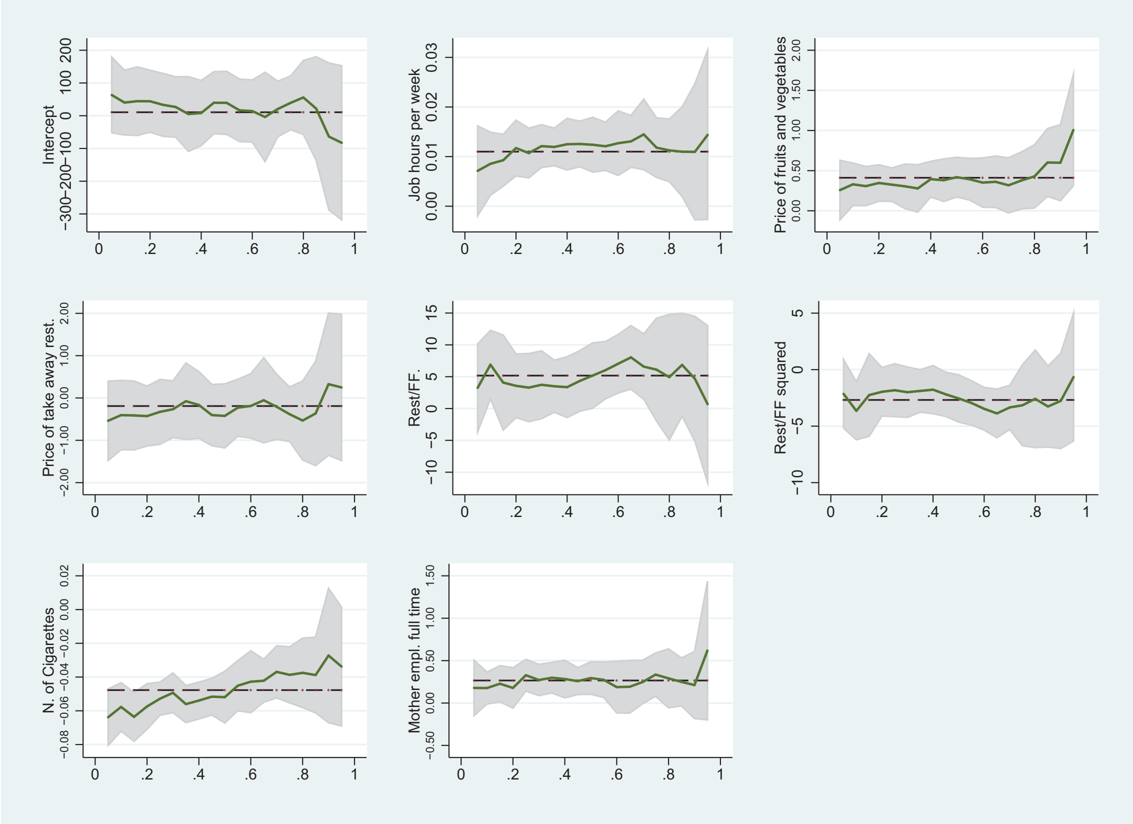

Figure 5: Quantile regression estimates: model (1), male

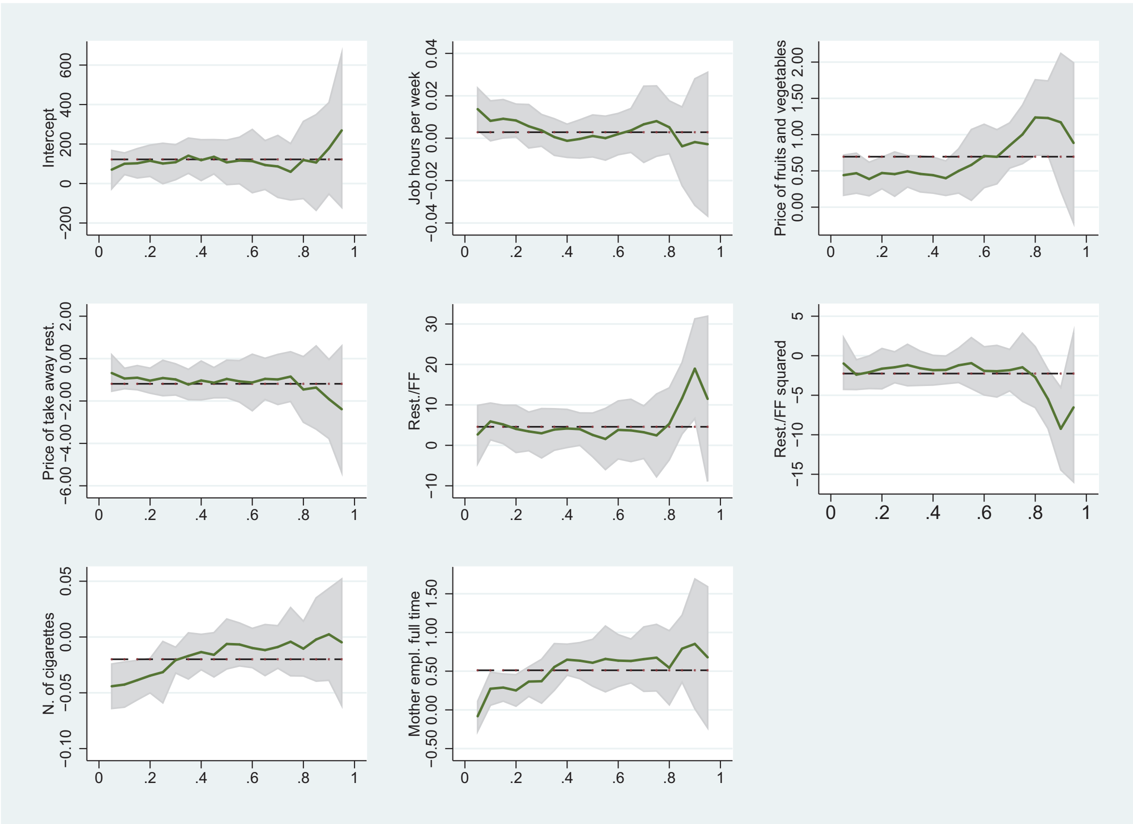

Figure 6: Quantile regression estimates: model (1), female

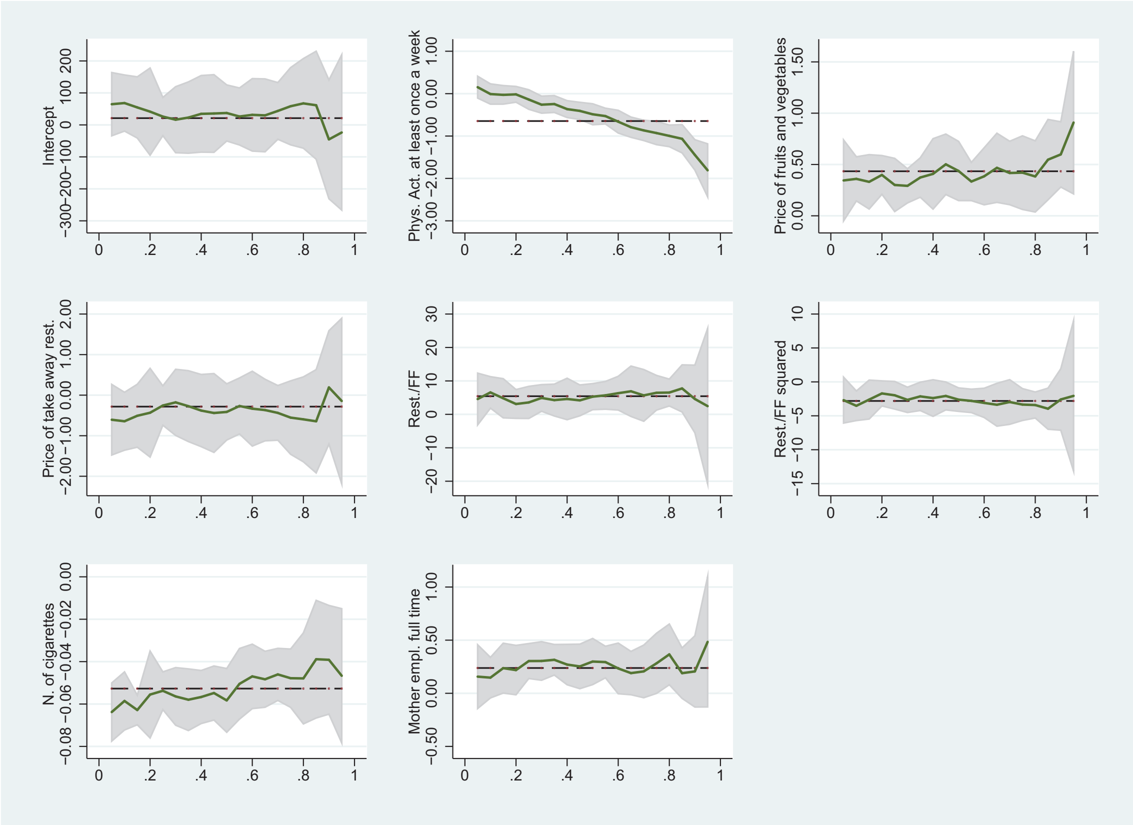

Figure 7: Quantile regression estimates: model (2), male

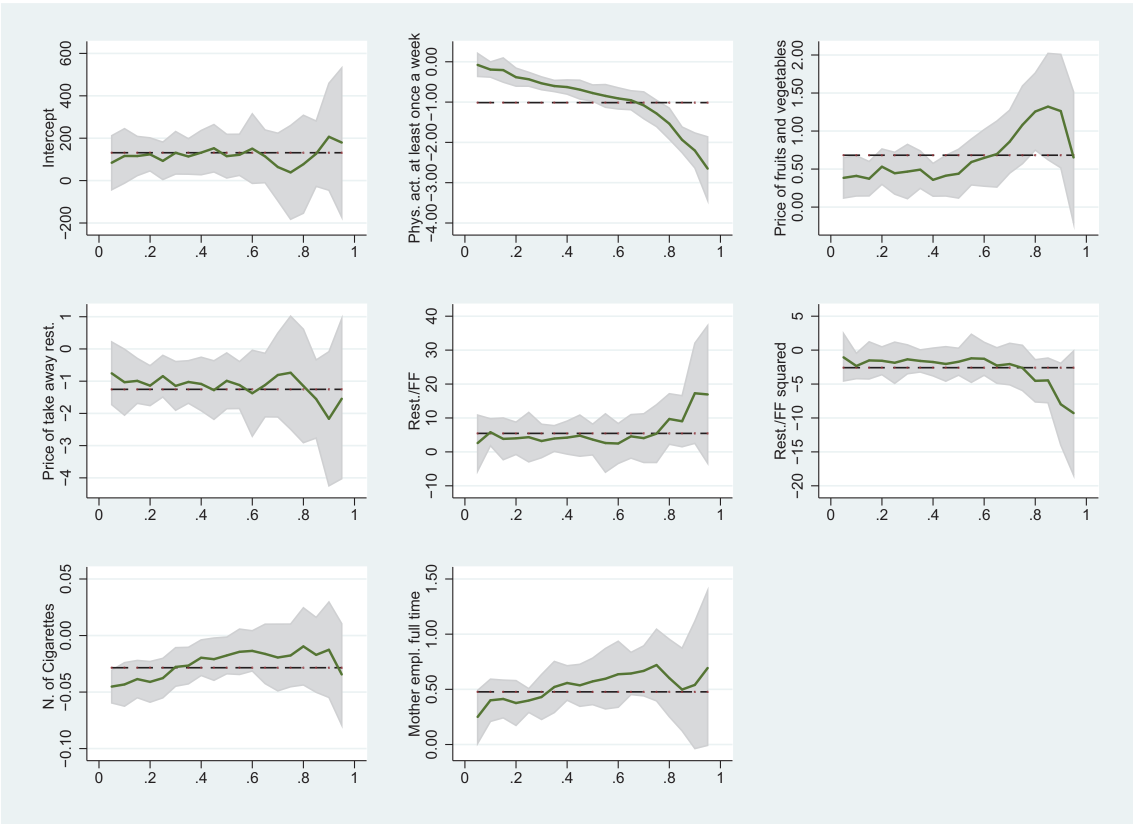

Figure 8: Quantile regression estimates: model (2), female

90^{th} percentile. The dimension of these effects is also confirmed by including the presence in the household of a working mother.

The density of full-service and fast-food restaurants is significant for some quantiles of the samples analysed. Their growing availability positively affects men's BMI, with positive and significant coefficients in the 10^{th}, 50^{th} and 90^{th} quantiles, and is barely significant for the OLS model. The coefficient is almost the same across quantiles, except for the 90^{th} percentile, where its measure is three times larger than that of OLS. Apart from the 90^{th} quantile parameter, none of the others is significant for women. These estimates are consistent with the results obtained by Chou et al. (2004). The density of restaurants and fast-food shops induces an increase in the BMI in men who spend more time at work while, on average, it is less responsible for increased BMI in women. This result is contradicted by the estimates at the 90^{th} quantile, where the values for overweight women become statistically significant.

In line with the explanation for men, the effect of the spread of restaurants and fast-food outlets on high BMI seems to depend positively on extra time worked, stimulating a demand for outside food, mainly fast-food, which increases calorie intake[15]. Lastly, also in the UK a negative association between cigarette consumption and BMI is empirically confirmed, and this is true for each estimated quantile except the most extreme deciles. Policy-makers should note that the significance of OLS estimates is due to the contributions up to the 75^{th} percentile, although this effect on BMI is lower in women (see parameters of Table 5)[16].

As discussed in section 3, we estimate quantile regressions for the subsample of people aged over 50, assumed to be stable to long-term imbalances in energy intake and expenditure. The results are listed in Appendixes A and B. With respect to the estimates for the complete sample showed in Table 4 and 5, we do not find remarkable differences in the coefficients of covariates affecting weight distribution. Only for several central quantiles, we denote slightly larger difference of the estimated parameters of age covariate between two samples. This implies that we cannot reject a BMI's steady-state condition and consistently estimate the behaviour of UK adults using the complete sample[17].

Table 6 lists the estimated BMI effects of a 1% increase in the covariates de-

[15] Although data are not reported, the dataset does show a positive relationship between extra job hours and larger share of women's BMI. This additional analysis is available from the authors upon request.

[16] In the specification of model 1, the contribution to the aggregate impact of cigarettes on BMI is also significant at the 75^{th} percentile for women.

[17] We also performed estimations that included higher polynomial orders of age covariate. The estimates were close to those reported in Table 4 and 5 and Appendix A and B, that included the covariate age and age squared.

scribed above. As previously stated, health policies based on OLS results would not efficiently measure their influence on overweight and policy suggestions. For example, if we focus on the price of fruit and vegetables, we note low estimated elasticity from OLS for men and women, but it becomes larger in quantile regressions when we consider women located beyond the 75^{th} percentile. The Table shows that most of these effects are quite minor, and often fail to be large or precisely measured enough to achieve statistical significance. The results thus indicate that changes in the price of fruit and vegetables affect each quantile of the BMI distribution with moderate effects for overweight people. Restaurant and fast-food densities have a significant effect on weight for men and women over the 50^{th} percentile. As expected, the number of cigarettes has a significant negative effect on body weight for much of the empirical distribution.

Table 6: BMI effect of a 1% increase of selected variables: model(1)

	OLS		**Q 0.1**		**Q 0.25**		**Q 0.5**		**Q 0.75**		**Q 0.9**	
Variable	M	F	M	F	M	F	M	F	M	F	M	F
Job_hours (x100)	0.042***	-0.016	0.039***	0.031*	0.045***	-0.001	0.048***	-0.02	0.041***	-0.022	0.035**	-0.022
	(0.012)	(0.021)	(0.011)	(0.017)	(0.009)	(0.017)	(0.01)	(0.018)	(0.012)	(0.024)	(0.014)	(0.034)
$\text{Price}_{F\&V}$	0.016***	0.024***	0.015**	0.016***	0.014***	0.017***	0.016***	0.021***	0.013***	0.03***	0.019***	0.029***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)	(0.007)	(0.011)
Price_{TA}	-0.007	-0.042***	-0.019	-0.034	-0.014	-0.044***	-0.016	-0.037**	-0.013	-0.038**	0.01	-0.055
	(0.011)	(0.012)	(0.02)	(0.023)	(0.012)	(0.016)	(0.014)	(0.015)	(0.016)	(0.019)	(0.026)	(0.039)
Rest/FF	0.196*	0.181	0.317**	0.223**	0.14	0.156	0.201***	0.164	0.214*	0.179*	0.149	0.547***
	(0.119)	(0.13)	(0.154)	(0.108)	(0.104)	(0.101)	(0.071)	(0.103)	(0.119)	(0.106)	(0.182)	(0.196)
N_Cigarettes	-0.002***	-0.001***	-0.003***	-0.003***	-0.002***	-0.002***	-0.002***	-0.001**	-0.001***	-0.001**	-0.001*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Net_Income	-0.004	-0.051***	0.017	0.008	0.018	-0.032**	0.006	-0.057***	-0.024	-0.044*	-0.014	-0.081**
	(0.021)	(0.02)	(0.028)	(0.015)	(0.019)	(0.014)	(0.021)	(0.014)	(0.029)	(0.025)	(0.042)	(0.038)

*Note: Standard errors are shown in round brackets and significant levels are reported with the following notation: p-value *** $\leq$ 0.01, ** $\leq$ 0.05, * $\leq$ 0.1.*

However, these effects may have more intuitive implications when they are expressed as changes in body weight due to policy interventions. Let us consider a representative adult at the average of the sample and at the 90^{th} percentile of the conditional BMI distributions for men and women. Admit a subsidy which decreases the price of fruit and vegetables and encourages the consumption of these healthier food. The value of these ''thin subsidies" is assumed to be 20% of the market price. Following our OLS estimates in Table 6 (model 1) carried out by gender, BMI would decrease by about 0.32% for men and 0.47% for women but would increase to 0.38% and 0.58%, respectively, when we measure the effects for people at the 90^{th} percentile. This means that a man 1.75 m tall, weighting 80.23 kg at the mean of the sample, corresponding to the average BMI (26.2) could expect to be lighter by 0.26 Kg per year, whereas a representative woman (height 1.61 m and BMI 25.43) could expect a decrease of 0.33 kg if price subsidies for healthy food were available. This reduction is emphasised when we evaluate people at the 90^{th} percentile. In this case, the effects of reduced body weight are 0.37 kg for men and 0.51 kg for women. We do not have a specular proxy for evaluating the effects of taxation on unhealthy foods. We note that, as an alternative impact on body weight, several countries plan to impose or broaden sales taxes on soft drinks and other food items (for a discussion, see Uhlman, 2003). This is in line with several recent laws passed to discourage the consumption of unhealthy foods by increasing their effective prices to consumers. The UK has considered the introduction of various value-added taxes for food of poor nutritional value (Kuchler et al., 2005; Schoreter et al, 2008) although this has been recognised as a progressive burden for low-income families which spend a large portion of their income on food (e.g., Cash et al., 2004).

We can repeat the exercise for changes in income. In addition to ''fat" taxes and ''thin" subsidies, several studies have determined that income has a major influence on obesity (e.g. Deaton, 2003; Drenowsky, 2003). In developed economies, households with higher incomes tend to consume higher-quality diets consisting mainly of low-calorie foods, whereas low-income households, which generally use more energy-dense foods, have problems of overweight. Note that from our estimates this evidence is only partly sustained. Only non-working women show significant reductions in overweight and obesity as a response to increases in income. Consequently, any policy that reduces inequalities in the income distribution across women can reduce overweight. As a quantitative example, a hypothetical increase in income of 10%, generated through public intervention, is reflected in a decrease in women's weight by 0.35 Kg, which more than doubles (-0.72 kg) when obese women at the 90^{th} percentile are taken into account.

Extensive medical literature supports the popular contention that smoking facilitates weight control. Our OLS estimates provide evidence of this smoking/obesity link. However, we also find that smokers who give up smoking lead to a different gender influence on BMI, which is greater in men. Let us assume that there is a 5% change in men and women quitting smoking. For the representative men and women in terms of BMI described above, a reduction in smoking causes an increase in men's weight of 2.5 kg and 1.3 kg in women[18].

[18] Although Chou et al. (2004) found that restrictions on cigarette smoking in restaurants played no role in weight outcomes, the estimated result may be slightly underestimated, because as from March 2006 a comprehensive ban on smoking in all enclosed public places was introduced in Scotland. This policy was subsequently extended to Wales (April 2007) and England (July 2007).

Now, we make the average impact of quitting smoking more realistic on weight by using BHPS surveys and showing it for the quantile distribution. Of course, political anti-smoking interventions and changes in factors beyond the control of individual behaviour lead smokers not only to quit smoking but also to smoke less, and this second effect may affect body weight. Under the assumption that smokers smoke a stable number of cigarettes per day, in one year we can estimate a smoking reduction of 2% for men and 1.5% for women and identify the weight changes as derived from those of ex-smokers[19]. The weight effects and confidence intervals are shown in Figure 9, which shows that the association between smoking and BMI is quite weak (or not significant at the 90^{th} percentile) among subjects whose BMI are at the end of the distribution, but are considerably stronger among subjects in the healthy weight range. Unlike the results obtained by Chou et al. (2004), the estimates cannot confirm that higher cigarette consumption will lead to increased obesity, because they vary on where the individual falls in the conditional BMI distribution. Instead, these results are close to the evidence reported by Fang et al. (2009) for China and Flegal (2007) for the United States.

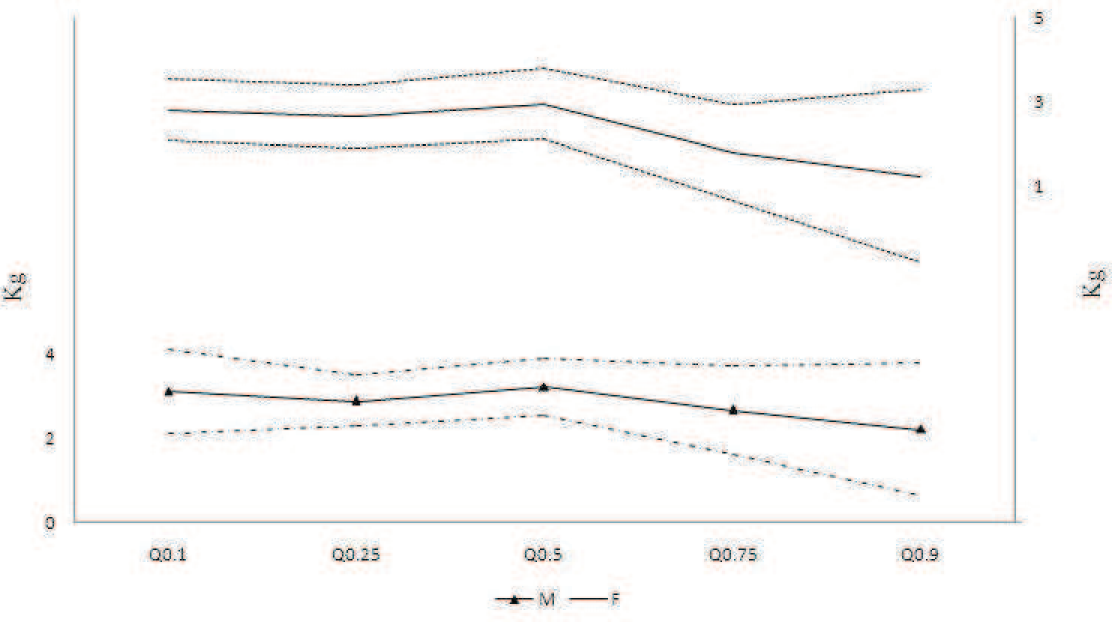

Figure 9: Weight (Kg) effect of a decrease in the UK cigarette consumption (2004-2006) by gender; (Male=2% per year; Women=1.5% per year)

Table 7 shows the weight effect (in kg) determined by changes in cigarette consumption within the usual clinical classes of body fat (the values are reported in column 3 in percentage and on average for each year). As argued above, we follow

[19]This hypothesis is empirically supported by BHPS surveys. On average, smokers consume 15.10 cigerettes in 2004 and 15.45 in 2006.

people for two years, a span assumed to be sufficiently large in assessing the link between smoking reduction and steady-state body weight[20]. As expected, the dimension and significance of the elasticities, calculated at the median of each class, are in line with those obtained through quantile regression. It is worth noting that the aggregation in standard clinical classes of body fat produces insignificant effects of smoking changes on obesity class, irrespective of whether they are men or women, so that a reduction in overall smoking rate in the population might not be accompained by an increase in obesity rates. Interestingly, changes in weight are, on average, higher for men and affect not only individuals whose BMI fall within the healthy weight range (BMI 20-24.99=1.44 and 0.826 Kg for men and women, respectively), but also mainly affect underweight people (BMI<20=2.108 Kg for men) and, less importantly, overweight people (BMI 25-29.99=0.947 kg for men and 0.547 kg for women). The dimension of the gained weight in response to quit smoking in the UK is in line with the results estimated on average of 1.82 kilos by the US Surgeon General (US Department of Health and Human Services, 1990), that included 20000 ex-smokers observed.

Table 7: Weight effect (in Kg and per year) of quitting smoking in UK (2004-2006)

Male						
BMI	Estimated elasticity (%)	t-test	% of people quitting smoking	Height	Median BMI$^{\pm}$	Change in weight (kg)
< 20	-0.004***	-6.104	0.027	179.443	19.248	2.108
20 - 24.9	-0.002***	-9.571	0.023	177.008	23.148	1.444
25 - 29.9	-0.002***	-4.996	0.018	176.844	27.321	0.947
> 30	-0.001	-1.761	0.015	176.167	32.765	0.582

Female						
BMI	Estimated elasticity (%)	t-test	% of people quitting smoking	Height	Median BMI$^{\pm}$	Change in weight (kg)
< 20	-0.003***	-7.280	0.018	163.493	19.022	0.959
20 - 24.9	-0.002***	-6.073	0.019	163.481	23.001	0.826
25 - 29.9	-0.001***	-3.238	0.018	162.053	27.397	0.547
> 30	-0.001	-1.457	0.011	161.269	33.987	0.265

Note: $\pm$ The median BMI rappresent the median BMI for each class and has been calculated dropping those individuals with BMI $\leq$ 15.
We choosed the median value for each class of BMI in order to obtain a rappresentative individual for the calculations reported in the table above. According to the empirical distributions of BMI: men with BMI $<$ 20 are enclosed up to 4.14% of our sample, 20 - 24 between 4.15% and 38.81%, 25 - 29 between 40.74% and 83.19%, and $>$ 30 between 83.2% - 100%. While, women with BMI $<$ 20 up to 8.58%, 20 - 24 between 8.59% and 50.95%, 25 - 29 between 50.96% and 82.41%, $>$ 30 between 82.43% and 100%.

In summary, these findings suggest that, while stopping smoking may lead to a

[20] Although Froom et al. (1999) state that return to weight equilibrium asks enough time, a period of two years is the followup period used by the US Surgeon General (US Department of Health and Human Services, 1990) study to verify if ex-smokers gained weight. In addition, Caan et al. (1996) argued that the period to return to equilibrium weight may be shorter because the clinical evidence suggests the existence of a fast return in energy intake to baseline levels.

moderate weight gain among subjects of healthy weight also when we use the clinical classes of the body weight, the effects on obese subjects are really modest for men and non-significant for women. From a policy perspective, the negative patterns in smoking consumption, which are complements with the recent anti-smoking policies and generally favoured by society, should not be expected to lead to an increase in obesity prevalence rates. This implies that the cost in terms of a loss of health due to the increase in overweight subjects, which must be paid in order to achieve the goal of a reduction in smoking, does not clearly emerge in the UK.

7 Conclusions

Many factors have been considered in assessing the determinants of overweight and obesity. The economic literature on the subject is slowly coming to an agreement on some issues, although many still remain unresolved. For instance, in her review of the extant literature, Rosin (2008) identifies the dynamics of relative food prices, technological changes in producing and distributing food, and the environmental influences of modern society among the most important contributors of the recent rise in obesity. However, this literature has not yet examined and thoroughly tested the role of the socio-economic determinants of overweight in the UK. We address this issue in our study, because the UK is the most problematic European country in terms of obesity.

Although the causes of obesity have attracted the interest of economists from a time-series perspective, the contribution of this work is to examine the sensitivity of determinants to the conditional distribution of body weight across individuals by means of data from two waves of the BHPS. Different effects of socio-economic causes on individual body weight have important implications as regards whether the UK government should recommend policies for adult obesity reduction.

Our OLS regression results support literature findings regarding the significant determinants of obesity. However, quantile regressions reveal the sensitivity of these determinants to BMI distributions. While significant in the OLS case, a lack of physical exercise consistently increased BMI only at higher levels of the quantile distribution, reinforcing findings that proper physical exercise can reduce the phenomenon of obesity. From evidence that there are remarkable differences in gender behaviour, the most significant revelation regards the relative prices of food. The effect of higher prices for healthy foods such as fruit and vegetables in increasing body weight is significant in all the quantiles of the specifications proposed, and stronger in obese people, although its influence in reducing body weight appears to be quite small. Also, the effect on BMI of a reduction in the relative prices of take-away restaurants is significant and increasing for women but is not statistically significant for men.

In other important differences, our results reveal that the most obese people are less so as men do not spend so much extra-time at work. However, the increased density of restaurants and fast-food shops, while non-significant in the OLS case, does affect the calorie intake and consumption of overweight people, with a remarkable effect for women over 90^{th} quantile. A key implication of our findings is that obesity control policies are unlikely to succeed equally across gender at different BMI levels.

These results imply that other health policies may have effects in reducing obesity. This does not seem to be the case of UK smokers who are quitting the habit. Weight seems to rise moderately at a decreasing rate, except the most obese people and, to a lesser extent in women. Although the policies targeted at cutting individual smoking may include elements aimed at counterbalancing the slight effects in increasing weight described in this analysis, the cost of their implementation will tend to worsen the UK fiscal policy burden without providing benefits for the society.

In conclusion, we make some suggestions for extending this line of research. When covariates are measured at levels other than individual - as, for example, relative prices at regional level in our sample, or in the recent literature (Auld and Powell, 2008) - we could better understand the determinants of obesity by specifying multilevel models. Such a framework would allow us to test the relationships obtained by variables built with individual data, increased by some of the underlying regional factors (and variability) which affect obesity. In addition, the problem of the possible simultaneity between BMI measures and some of their determinants when the latter are not collected at individual level, while recognised in the literature, needs to be resolved in estimations.

References

Auld, M.C., Powell, L.M., 2009. Economics of food energy density and adolescent body weight. Economica forthcoming.

Atella, V., Pace, N., Vuri, D., 2008. Are employers discriminating with respect to weight?: European Evidence using Quantile Regression. Economics and Human Biology, Elsevier, vol. 6(3), 305-329.

Ball, K., Crawford, D., 2005. Socioeconomic status and weight change in adults: a review. Social Science & Medicine, 60, 1987-2010.

Baum, C. L., 2009. The effects of cigarette cost on BMI and obesity. Health Economics, 18, 319.

Blanchflower, D.G., Oswald, A.J., Van Landeghem B., 2009. Imitative Obesity and Relative Utility. Journal of the European Economic Association, (7) 2-3, 528-538.

Bleich, S., Cutler, D., Murray, C.J. and Adams A., 2007. Why is the developed World obese? NBER working paper 12954, National Bureau of Economic Research, Cambridge MA.

Becker, G.S., 1965. A theory of the allocation of time. Economic Journal 75, 493-517.

Brunello, G., Michaud, P.C., Sanz-de-Galdeano, A., 2009. The rise of obesity in Europe: an economic perspective. Economic Policy, vol. 24, pages 551-596.

Burkhauser, R.V., Cawley J., 2008. Beyond BMI: The value of more accurate measures of fatness and obesity in social science research. Journal of Health Economics 27(2), 519-529.

Caan, B., Coates, A., Schaefer, C., Finkler, L. et al., 1996. Women gain weight 1 year after smoking cessation while dietary intake temporarily increases. Journal of the American Dietetic Association, 96 (November), 11 (health module).

Cash, S.B., Sunding, D.L., Zilberman, D., 2004. Fat taxes and thin subsidies: prices, diet and health outcomes. Annual meeting of American Agricultural Economics Association, Denver, CO, August 1-4.

Cawley, J., 1999. Rational addiction, the consumption of calories, and body weight. Ph.D. dissertation, University of Chicago.

Cawley, J., 2004. The impact of obesity on wages. Journal of Human Resources, 39(2), 451-474.

Cawley, J., Markowitz S., Taurus, J., 2004. Lighting up and slimming down:

the effects of body weight and cigarette prices on adolescent smoking initiation. Journal of Health Economics 23 , 293311.
Chou, S., Grossman, M., Saffer, H., 2004. An economic analysis of adult obesity: results from the behavioral risk factor surveillance system. Journal of Health Economics, 23: 565-587.
Classen, T., 2005. Intergenerational obesity transmission and correlations of human capital accumulation. Working paper, University of Wisconsin, Madison.
Commission of the European Communities, 2005. Green Paper Promoting healthy diets and physical activity: a European dimension for the prevention of overweight, obesity and chronic diseases COM, 2005, 637.
Costa-Font, J., Fabbri, D., Gil, J., 2009. Decomposing body mass index gaps between Mediterranean countries: A counterfactual quantile regression analysis. Economics and Human Biology, 7, 351-365.
Costa, D.L., Steckel R.H., 1997. Long-term trends in health, welfare, and economic growth in the United Stated. In: Steckel, R.H., Floud, R (Eds.), Health and Welfare During Industrialization. University of Chicago Press, Chicago, 47-89.
Currie, J., Della Vigna, S., Moretti, E., Pathania, V., 2010. The Effect of Fast Food Restaurants on Obesity and Weight Gain. American Economic Journal: Economic Policy, 2(3), 32-63.
Cutler, D.M., Glaeser, E.L., Shapiro, J.M., 2003. Why Have Americans Become More Obese? Journal of Economic Perspectives, 17(3), 93-118.
Deaton, A., 2003. Health, income and inequality. NBER Research Reporter: Research summary, http://www.nber.org/reporter/spring03/health.html.
Department of Health (2006). Forecasting Obesity to 2010.
Drewnowski, A., 2003. Fat and Sugar: an economic analysis. Journal of Nutrition, 133, 838S-840S.
Drewnowski, A., Darmon, N., Briend, A., 2004. Replacing fats and sweets with vegetables and fruits – a question of cost. American Journal of Public Health, 94(9), 1555-1559.
Drewnowski, A., Specter, S., 2004. Poverty and obesity: the role of energy density and energy costs. American Journal of Clinical Nutrition, 79, 6-16.
Fang, H., Ali, M.M., Rizzo, J.A., 2009. Does smoking affect body weight and obesity in China? Economics and Human Biology, 7, 334-350.

Flegal, K.M., 2007. The effects of changes in smoking prevalence on obesity prevalence in the United States, American Journal of Public Health 97, 1510-1514.
French, S.A., Jeffery, R.W., 1995. Weight concerns and smoking: a literature review. Annals of Behavioral Medicine, 17, 234-244.
Froom, P., Kristal-Boneh, E., Melamed, S., Gofer, D., Benbassat, J., Ribak, J., 1999. Smoking cessation and body mass index of occupationally active men: the Israeli CORDIS Study. American Journal of Public Health, American Public Health Association, 89 (5), 718722.
Goldin, C., Katz, L.F., 2002. The power of the pill: oral contraceptives and women's career and marriage decisions. Journal of Political Economy, 110, 730-770.
Görg, H., Strobl E., 2002. Multinational companies and entrant start-up size: evidence from quantile regression, Review of Industrial Organization, Springer, 20(1), 15-31, February.
Gruber, J., Frakes M., 2006. Does falling smoking lead to rising obesity? Journal of Health Economics, 25, 183-197.
Grunberg, N.E., 1985. Nicotine, cigarette smoking, and body weight. British Journal of Addiction, 80, 369377.
Hartog, J., Pereira, P.T., Vieira, J.A.C., 2001. Changing Returns to education in Portugal during the 1980s and early 1990s: OLS and quantile regreassion estimators. Applied Economics, Taylor and Francis Journals, 38, 1021-37, June.
House of Commons Health Committee, 2004. Obesity.
Kamhon, K., Wei-Der T., 2004. Obesity and risk knowledge. Journal of Health Economics, 23(5):907, 34.
Klesges, R.C., Meyers, A.W., Klesges, L.M., LaVasque, M.E., 1989. Smoking, body weight, and their effects on smoking behavior: a comprehensive review of the literature. Psychology Bulletin, 106, 204230.
Koenker, R., Basset, G., 1978. Regression quantiles. Econometrica, 46, 33-50.
Koenker, R., Basset, G., 2001. Quantile regression. Journal of Economic Perspectives, 15, 143-156.
Kuchler, F., Tegene A., Harris, J.M., 2005. Taxing snacking foods: manipulating diet quality or financing information programs? Review of Agricultural Economics, 27, 4-20.
Lakdawalla, D., Philipson,T., 2009. The growth of obesity and technological

change. Economics and Human Biology, 7, 283–293.

Loureiro, M.L., Nayga, R.M., 2005. Obesity rates in OECD countries: an international perspective. 2005 International Congress, August 23-27, 2005, Copenhagen, Denmark 24650, European Association of Agricultural Economists.

Michaud, P.C., Soest, A., Andreyava, T., 2007. Cross country variation in obesity patterns among older Americans and Europeans. Forum for Health Economics and Policy, 10(2):8.

National Audit Office, 2001. Tackling Obesity in England.

National Health Service, 2009. Statistics on Obesity, Physical Activity and Diet: England, February 2009.

Nonnemaker, J., Finkelstein, E., Engelen, M., Hoerger, T., Farrelly, M., 2009. Have efforts to reduce smoking really contributed to the obesity epidemic?. Economic Inquiry, 47, 366376.

Office for National Statistics and Department for Environment, Food and Rural Affairs, Expenditure and Food Survey, 2006. SN: 5210. 3rd Edition. Colchester, Essex: UK Data Archive Office for National Statistics, July 2009. SN: 5986.

Office for National Statistics and Department for Environment, Food and Rural Affairs, Expenditure and Food Survey (2006). SN 5986. 3rd Edition. Colchester, Essex: UK Data Archive Office for National Statistics, July 2009. SN: 5986.

Philipson, T., Posner R.A., 1999. The long run growth in obesity as a function of technological change. NBER Working Paper 7423.

Philipson, T., 2001. The world-wide growth in obesity: an economic research agenda. Health Economics, 10, 1-7.

Pieroni, L., Lanari D., Salmasi L. (2010). Food Prices and Overweight Patterns in Italy. MPRA Paper 23744, University Library of Munich, Germany.

Public Health Information for Scotland, 2007. Obesity in Scotland: an epidemiology briefing.

Quintana, D.C., 2005. The income gradient in body mass index. Working paper, Princeton University.

Rashad, I., Grossman, M., 2004. A realistic look at obesity. Public Interest, 156, 104-112.

Rashad I., Grossman M., Chou S., 2006. The super size of America: an economic estimation of body mass index and obesity in adults. Eastern Economic Journal, 32, 132-148.

Rosin, O., 2008. The economic causes of obesity: a survey. Journal of Economic Surveys, 22, 617-647.
Schlosser, E. 2001. Fast food nation. New York time Bestsellers.
Schroeter, C., Lusk J., and Tyner W., 2008. Determining the impact of food price and income changes on body weight. Journal of Health Economics, 27, 45-68.
The NHS Information Centre, 2008. Health Survey for England 2006.
The NHS Information Centre, 2007. Hospital Episode Statistics (HES).
Thow, A.M., Quested, C., Juventin, L., Kun, R., Khan, N.A., Swinburn B., 2010. Taxing soft drinks in the Pacific: implementation lessons for improving health. Health Promotion International, doi:10.1093/heapro/daq057.
Uhlman, M. (2003). “State legislatures fighting fat.” Charlston Gazette, August 24.
University of Essex. Institute for Social and Economic Research, British Household Panel Survey: Waves 1-18, 1991-2009 [computer file]. 7th Edition. Colchester, Essex: UK Data Archive [distributor], July 2010. SN: 5151.
US Department of Health and Human Services (1990). “The Health Benefits of Smoking Cessation: A Report of the Surgeon General.” Rockville, MD: Office on Smoking and Health. *DHHS Publication CDC* 90-8416.
WHO, 2005. The European Health Report, Public health actions for healthier children and populations.
Zagorsky, J.L., 2005. Health and wealth. The late-20th century obesity epidemic in the U.S. Economic and Human Biology, 3, 296-313.

APPENDIX A

Table A: BMI OLS and quantile regressions: model(1), people over 50

	OLS		**Q 0.1**		**Q 0.25**		**Q 0.5**		**Q 0.75**		**Q 0.9**	
Variable	M	F	M	F	M	F	M	F	M	F	M	F
Job_hours	0.001	-0.028***	0.004	-0.005	0.006	-0.013	0.010**	-0.02	0.002	-0.034**	-0.001	-0.081***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)	(0.007)	(0.006)	(0.011)
Strenuousness	-0.303	-0.518	0.077	-0.066	-0.02	-0.380	-0.096	-0.712**	-0.666**	-0.607	-0.788.	-0.085
	(0.250)	(0.319)	(0.271)	(0.368)	(0.220)	(0.285)	(0.149)	(0.318)	(0.286)	(0.512)	(0.413)	(0.736)
$Price_{F\&V}$	0.370*	0.711***	0.185	0.434	0.254	0.611**	0.604***	0.826***	0.621.	1.096***	0.480**	0.638
	(0.222)	(0.253)	(0.250)	(0.319)	(0.174)	(0.241)	(0.178)	(0.232)	(0.323)	(0.331)	(0.235)	(0.400)
Price_{TA}	-0.410	-1.422***	-1.262	-1.121*	-1.043	-1.503**	-0.610	-1.315*	-0.319	-1.425**	0.428	-1.452
	(0.456)	(0.475)	(0.789)	(0.629)	(0.660)	(0.740)	(0.698)	(0.710)	(0.785)	(0.718)	(1.512)	(1.326)
Rest/FF	-0.724	7.223	6.622	2.959	4.902	6.868*	-1.088	6.550	-6.530	5.137	-7.888	16.919**
	(5.145)	(5.289)	(6.471)	(5.104)	(4.633)	(3.997)	(4.759)	(5.707)	(5.270)	(5.967)	(9.371)	(8.592)
Rest/FF^2	0.125	-3.344	-3.602	-0.234	-2.342	-2.582	0.636	-2.963	3.016	-2.791	2.854	-8.353**
	(2.337)	(2.250)	(3.159)	(2.019)	(2.540)	(1.625)	(2.260)	(2.421)	(2.297)	(2.374)	(3.988)	(3.963)
N_Cigarettes	-0.062***	-0.061***	-0.078***	-0.087***	-0.072***	-0.089***	-0.067***	-0.053***	-0.062***	-0.052***	-0.048	-0.011
	(0.014)	(0.017)	(0.013)	(0.019)	(0.016)	(0.013)	(0.010)	(0.012)	(0.018)	(0.014)	(0.037)	(0.023)
Work_Mother	0.142	0.948***	0.374	0.549.	0.293	0.95***	0.179	1.137***	0.244	1.002**	0.005	1.595**
	(0.209)	(0.284)	(0.247)	(0.322)	(0.197)	(0.262)	(0.19)	(0.343)	(0.221)	(0.436)	(0.360)	(0.765)
Black	-0.514	2.033*	-0.177	-0.320	-0.145	2.755**	-0.161	2.155**	-0.533	1.891	-0.863	2.630
	(1.036)	(1.101)	(1.537)	(2.386)	(1.493)	(1.376)	(0.739)	(0.959)	(1.069)	(1.670)	(1.505)	(1.672)
Age	0.175	0.546***	0.239.	0.272	0.245**	0.496***	0.347***	0.649***	0.265***	0.515***	0.208	0.471*
	(0.116)	(0.122)	(0.132)	(0.168)	(0.105)	(0.092)	(0.072)	(0.126)	(0.093)	(0.153)	(0.205)	(0.245)
Age^2	-0.002**	-0.005***	-0.002**	-0.002**	-0.002***	-0.004***	-0.003***	-0.005***	-0.003***	-0.004***	-0.003*	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Net_Income	0.147	-0.167	0.07	-0.171	1.000	-0.293	-0.347	-1.415	-0.896	0.329	-0.112	0.327
	(0.859)	(0.974)	(1.014)	(1.027)	(0.846)	(0.810)	(1.312)	(0.957)	(0.868)	(2.036)	(1.724)	(2.119)
Net_Income^2	-0.774	0.123	-0.144	0.655	-0.853	0.306	-0.245	0.737	-0.398	-0.187	-1.221	-0.593
	(0.473)	(0.447)	(0.592)	(0.437)	(0.630)	(0.587)	(0.840)	(0.664)	(0.634)	(1.589)	(0.885)	(1.423)
Couple	-0.828	-0.758	0.231	0.789	-0.389	0.625	0.001	-0.142	-1.557	-0.871	-1.607	-2.700**
	(0.653)	(0.676)	(0.644)	(0.675)	(0.430)	(0.652)	(0.730)	(0.742)	(1.065)	(0.966)	(1.060)	(1.162)
Married	-0.665	0.014	0.122	0.775	-0.445	0.495	0.218	0.046	-1.079*	0.363	-2.107***	-0.799
	(0.493)	(0.542)	(0.402)	(0.616)	(0.374)	(0.415)	(0.434)	(0.438)	(0.631)	(0.750)	(0.692)	(1.095)
Divorced	-1.195*	0.756	-0.346	0.003	-0.995.*	0.554	-0.024	0.881	-1.148	1.483***	-2.197*	1.236
	(0.630)	(0.640)	(0.385)	(0.605)	(0.564)	(0.516)	(0.665)	(0.643)	(0.794)	(0.706)	(1.146)	(1.310)
Separated	-2.531***	1.459	-1.140	0.474	-1.498***	1.556**	-0.842	1.306	-3.261***	2.977.	-5.991***	1.345
	(0.796)	(1.213)	(0.827)	(1.935)	(0.488)	(0.727)	(0.943)	(1.759)	(0.751)	(1.664)	(1.362)	(1.825)
Widowed	-0.580	0.356	0.789	0.633	-0.135	0.441	0.273	0.379	-0.982	0.765	-2.295**	0.173
	(0.547)	(0.568)	(0.499)	(0.656)	(0.569)	(0.515)	(0.511)	(0.457)	(0.697)	(0.655)	(0.900)	(0.943)
Degree	-1.549***	-1.468***	-1.413***	-1.32***	-1.077***	-1.676***	-0.989***	-1.128***	-1.826***	-1.967***	-2.927***	-1.038
	(0.356)	(0.422)	(0.396)	(0.426)	(0.405)	(0.346)	(0.237)	(0.281)	(0.295)	(0.336)	(0.532)	(0.704)
Diploma	-0.760***	-1.144***	-0.054	-0.855***	-0.349*	-1.167***	-0.449**	-1.113***	-1.034***	-1.117***	-1.535***	-0.935**
	(0.240)	(0.252)	(0.306)	(0.194)	(0.197)	(0.197)	(0.182)	(0.254)	(0.275)	(0.291)	(0.448)	(0.473)
Alevel	-0.710**	-0.806.	0.277	-0.843*	-0.315	-1.132***	-0.303	-0.873***	-1.443***	-0.313	-2.167***	-0.612
	(0.357)	(0.452)	(0.314)	(0.442)	(0.362)	(0.339)	(0.275)	(0.251)	(0.264)	(0.604)	(0.547)	(0.901)
Olevel	-0.396	-0.757**	0.161	-0.513*	-0.126	-0.732***	-0.265	-0.855***	-0.604.	-1.127**	-1.027*	-0.450
	(0.309)	(0.312)	(0.288)	(0.301)	(0.189)	(0.280)	(0.233)	(0.278)	(0.354)	(0.464)	(0.542)	(0.492)
D_{2004}	-0.883***	-1.493***	-0.784	-0.548	-0.853**	-1.215***	-1.241***	-1.608***	-1.032**	-2.066***	-0.943*	-2.095***
	(0.282)	(0.313)	(0.493)	(0.437)	(0.348)	(0.399)	(0.284)	(0.425)	(0.470)	(0.434)	(0.538)	(0.729)
Constant	51.371	137.002**	160.410*	121.731	129.775	151.024	51.106	110.190	24.778	114.255	-50.989	153.887
	(54.818)	(55.373)	(95.565)	(84.828)	(84.982)	(92.669)	(88.972)	(88.426)	(95.051)	(94.332)	(192.407)	(160.665)
R^2	0.06	0.05	0.04	0.03	0.03	0.03	0.04	0.03	0.04	0.03	0.06	0.04

*Note: Standard errors are shown in round brackets and significant levels are reported with the following notation: p-value *** $\leq$ 0.01, ** $\leq$ 0.05, * $\leq$ 0.1. The description of variables are reported in Table 1.*

APPENDIX B

Table B: BMI OLS and quantile regressions: model (2), people over 50

	OLS		**Q 0.1**		**Q 0.25**		**Q 0.5**		**Q 0.75**		**Q 0.9**	
Variable	M	F	M	F	M	F	M	F	M	F	M	F
Phys_Activity	-0.579***	-1.576***	-0.003	-0.573***	-0.027	-0.968***	-0.418**	-1.309***	-0.797***	-2.085***	-1.182***	-2.521***
	(0.145)	(0.123)	(0.154)	(0.087)	(0.078)	(0.039)	(0.121)	(0.114)	(0.123)	(0.178)	(0.254)	(0.232)
Strenuousness	-0.334	-0.595*	0.111	-0.443	0.078	-0.534**	0.074	-0.697**	-0.779**	-0.457	-0.484	-0.936
	(0.243)	(0.313)	(0.178)	(0.313)	(0.259)	(0.236)	(0.260)	(0.345)	(0.336)	(0.405)	(0.447)	(0.630)
$Price_{F\&V}$	0.340	0.598**	0.171	0.417*	0.234	0.441**	0.649***	0.776***	0.646***	0.773**	0.785**	0.341
	(0.222)	(0.247)	(0.238)	(0.239)	(0.200)	(0.184)	(0.195)	(0.192)	(0.240)	(0.350)	(0.376)	(0.380)
Price_{TA}	-0.451	-1.452***	-1.16***	-1.147**	-0.988*	-1.468**	-0.975	-1.759***	-0.590	-1.372	0.580	-2.088*
	(0.452)	(0.471)	(0.453)	(0.579)	(0.592)	(0.716)	(0.713)	(0.636)	(0.810)	(0.999)	(1.062)	(1.113)
Rest/FF	-0.062	9.369*	6.812	4.242	5.813	7.627**	0.368	9.120**	-5.635	7.853	-2.975	18.982***
	(5.098)	(5.254)	(6.374)	(4.955)	(4.664)	(3.369)	(3.251)	(4.305)	(5.243)	(6.309)	(9.506)	(7.151)
Rest/FF^2	-0.192	-4.176*	-3.748	-0.776	-2.729	-2.835**	0.028	-3.728**	2.422	-3.951	1.248	-8.864***
	(2.317)	(2.239)	(3.009)	(1.965)	(2.206)	(1.361)	(1.495)	(1.833)	(2.204)	(2.732)	(4.636)	(2.758)
N_Cigarettes	-0.065***	-0.076***	-0.079***	-0.101***	-0.071***	-0.101***	-0.066***	-0.064***	-0.067***	-0.069**	-0.038	-0.035
	(0.014)	(0.016)	(0.012)	(0.011)	(0.014)	(0.012)	(0.01)	(0.013)	(0.021)	(0.029)	(0.025)	(0.026)
Work_Mother	0.092	0.327	0.380.	0.260	0.336	0.561***	0.202	0.574***	0.109	0.362	-0.264	0.142
	(0.204)	(0.234)	(0.201)	(0.261)	(0.212)	(0.156)	(0.206)	(0.216)	(0.280)	(0.387)	(0.323)	(0.395)
Black	-0.486	2.243**	-0.075	-0.424	0.051	3.497**	-0.149	3.124***	-0.796	2.065**	-1.108	2.812
	(1.037)	(1.111)	(1.188)	(1.697)	(1.894)	(1.505)	(0.967)	(0.993)	(0.955)	(0.990)	(1.483)	(2.098)
Age	0.203.	0.703***	0.232	0.299**	0.223**	0.578***	0.341***	0.763***	0.275**	0.722***	0.315	0.826***
	(0.111)	(0.118)	(0.143)	(0.124)	(0.114)	(0.081)	(0.109)	(0.107)	(0.108)	(0.177)	(0.272)	(0.144)
Age^2	-0.002***	-0.006***	-0.002**	-0.003***	-0.002**	-0.005***	-0.003***	-0.006***	-0.003***	-0.006***	-0.003.	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Net_Income	0.147	-0.632	0.144	0.303	0.994	-0.477	0.060	-1.532	-0.876	-1.275	0.266	-0.448
	(0.882)	(0.944)	(0.632)	(1.179)	(0.941)	(1.015)	(0.872)	(1.359)	(1.450)	(1.829)	(1.624)	(2.471)
Net_Income^2	-0.725	0.315	-0.157	0.352	-0.827	0.144	-0.311	0.839	-0.280	0.399	-1.221	-0.266
	(0.488)	(0.459)	(0.344)	(0.931)	(0.707)	(0.997)	(0.542)	(0.892)	(1.367)	(0.801)	(1.034)	(1.396)
Couple	-0.859	-0.869	0.292	0.604	-0.484	0.549	-0.046	-0.281	-1.603	-1.322	-1.892	-3.008**
	(0.651)	(0.669)	(0.484)	(0.677)	(0.491)	(0.658)	(0.530)	(0.784)	(1.045)	(0.930)	(1.906)	(1.292)
Married	-0.667	-0.054	0.148	0.538	-0.512	0.307	0.143	0.133	-1.199*	-0.003	-1.994*	-1.491
	(0.491)	(0.534)	(0.471)	(0.540)	(0.330)	(0.424)	(0.436)	(0.447)	(0.654)	(0.615)	(1.045)	(1.246)
Divorced	-1.180*	0.695	-0.357	-0.125	-1.076***	0.266	-0.202	0.870	-1.449**	1.078	-1.529	0.460
	(0.632)	(0.632)	(0.525)	(0.699)	(0.398)	(0.423)	(0.544)	(0.641)	(0.658)	(0.749)	(1.341)	(1.551)
Separated	-2.584***	1.520	-1.158	0.696	-1.449**	1.885***	-1.091	1.627	-3.256***	2.285.	-5.679***	0.987
	(0.818)	(1.118)	(0.939)	(1.410)	(0.575)	(0.727)	(1.171)	(1.497)	(0.729)	(1.190)	(2.080)	(2.326)
Widowed	-0.529	0.372	0.825	0.595	-0.125	0.469	0.280	0.513	-0.996	0.252	-1.805	-0.401
	(0.547)	(0.560)	(0.588)	(0.59)	(0.300)	(0.457)	(0.470)	(0.469)	(0.718)	(0.581)	(1.286)	(1.264)
Degree	-1.543***	-1.370***	-1.406***	-1.246***	-1.047***	-1.754***	-1.026**	-1.395***	-1.753***	-1.600***	-2.801***	-2.208***
	(0.352)	(0.412)	(0.270)	(0.386)	(0.351)	(0.286)	(0.408)	(0.458)	(0.373)	(0.289)	(0.503)	(0.656)
Diploma	-0.762***	-0.987***	-0.054	-0.759***	-0.314	-1.098***	-0.439*	-0.977***	-1.001***	-0.925****	-1.603***	-0.930**
	(0.238)	(0.247)	(0.198)	(0.179)	(0.209)	(0.201)	(0.246)	(0.239)	(0.302)	(0.318)	(0.258)	(0.397)
Alevel	-0.701**	-0.697	0.268	-0.919*	-0.313	-1.144***	-0.340	-0.753	-1.480***	-0.094	-2.177***	-0.489
	(0.356)	(0.455)	(0.330)	(0.502)	(0.231)	(0.350)	(0.397)	(0.479)	(0.278)	(0.534)	(0.623)	(0.724)
Olevel	-0.398	-0.685**	0.199	-0.492	-0.093	-0.902***	-0.307	-0.645***	-0.635**	-1.155***	-0.932.	-0.860
	(0.307)	(0.308)	(0.318)	(0.308)	(0.232)	(0.197)	(0.314)	(0.233)	(0.324)	(0.361)	(0.477)	(0.633)
D_{2004}	-0.899***	-1.451***	-0.802**	-0.556**	-0.829**	-1.118***	-1.359***	-1.543***	-1.396***	-1.698***	-1.227**	-1.681***
	(0.281)	(0.308)	(0.330)	(0.277)	(0.327)	(0.278)	(0.381)	(0.332)	(0.412)	(0.545)	(0.546)	(0.611)
Cons.	57.969	143.655***	148.677**	125.599	124.757	156.885*	94.344	165.653**	58.121	124.540	-99.315	244.998*
	(54.418)	(54.803)	(63.649)	(82.289)	(77.051)	(90.381)	(83.130)	(78.065)	(98.150)	(123.968)	(131.879)	(135.358)
R^2	0.07	0.07	0.04	0.04	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.06

*Note: Standard errors are shown in round brackets and significant levels are reported with the following notation: p-value *** $\leq$ 0.01, ** $\leq$ 0.05, * $\leq$ 0.1. The description of variables are reported in Table 1.*