The Income Gradient in Body Mass Index

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Abstract

In this paper I analyze the income gradient in Body Mass Index (BMI) for ten European countries. Given the growing obesity epidemic over the entire world, knowledge about this relation is crucial. My results support the previous existing empirical: for women, BMI and income are negatively related. Moreover, the protective power of income increases with BMI. For men, the relationship is positive and no clear pattern emerges through their BMI distribution. Making use of a potential source of exogenous variation in income, it seems that the negative causal effect of income on BMI cannot be discarded for women.

Key Words: Lottery Prizes; Obesity; Public Health; Quantiles; Socioeconomic Status.

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"Obesity is rising rapidly, and Europe's expanding waistline brings with it devastating consequences for public health and huge economic costs."

Markos Kyprianou, European Commissioner for Health and Consumer Protection. Brussels, March 15, 2005.

1. Introduction

It is a well-known fact that the high growing trends of overweight and obesity in many developed countries are major public health concerns, since both are risk factors for numerous health problems and many chronic diseases[1]. According to the WHO (2003), obesity prevalence has increased by 10-40% in most European countries over the last decade. Moreover, and what it seems to be more alarming, obesity among children is growing fast, specially, in the south of Europe, with rates from 20% to more than 35% (IOTF, 2002, 2003). In front of this situation, it is a priority to understand the

[1] Overweight and obesity are usually defined by means of the Body Mass Index (BMI). The BMI is a standard measure expressing the ratio of weight (in kilograms) to height (in square meters). According to the National Research Council, NCR, (1989), the BMI is more highly correlated with body fat than any other indicator of height and weight. Overweight ($25 \leqslant BMI < 30$, according to the WHO) refers to increased body weight in relation to height, when compared to some standard of acceptable or desirable weight (NRC, 1989; Stunkard et al., 1993). Obesity ($BMI \geqslant 30$, WHO) is defined as an excessively high amount of body fat or adipose tissue in relation to lean body mass (NRC, 1989; Stunkard et al., 1993). The mortality risk is relatively constant in the range 21-28. Below 21, adult mortality rises sharply. Above 28, this also increases. Although BMI is associated with higher mortality from all causes, the causal effect of BMI on mortality may be confounded by past smoking behavior or previous diseases (Wilson, 2001). See also Waaler (1984).

determinants of the body mass index (BMI), and those of overweight, and obesity in particular, the biggest single European public challenge of the 21st century (IOTF, 2002).

Several different groups of factors play a role in the determination of obesity: behavioral, genetic, socioeconomic, sociocultural, environmental, etc. Hence, it is very important to exploit the synergy of research in this topic from different fields. In this paper, I will try to provide new evidence on the role of income as a determinant of BMI.

A part of being a risk factor of several health complications, and as pointed out by Philipson (2001), obesity is also a major health economics and public finance issue. Hence, there are several reasons why it is important that economists focus their attention to the study of the BMI-income relation, both from an efficiency perspective, and also from an equity point of view[2]. On the one hand, obesity is imposing a big pressure on national heath care systems of European countries. In their empirical review about estimates of obesity-related costs (based on ten-years ago data), Thompson and Wolf (2001) show that these account for 2 and 3.5% of the overall health budgets in France and Portugal, respectively. But given the current fast growing trends in obesity, and that these estimates are outdated, these are considered, in general, as lower bounds to the actual costs. Taking these conservative estimates, and given the magnitude of public health expenditure in European countries, these are translated to a 0.32% of the GDP of Portugal and 0.34% in the case of France, for example. Thus, knowledge about the BMI-income

[2] There are several papers about obesity from an economic perspective. Some of these are interested in the determinants of obesity (see for example, Philipson and Posner, 1999; Philipson and Lakdawalla, 2002; Levy 2002; Cutler et al., 2003; Chou et al., 2004; Komlos et al., 2004). Others are focused on the effect of obesity on labor market outcomes, employment, earnings, etc. (see for example, Hammermesh and Biddle, 1994; Averett and Korenman, 1996; Cawley, 2000, 2004).

relation is important in order to determine what kind of public policy is more cost-effective. Suppose, for example, that income is an overweight-obesity protective factor, i.e., a higher level of income reduces the prevalence of obesity. From a policy maker point of view, this information is necessary to compare the costs and benefits of spending more resources to cover obesity associated health costs with those associated with income redistributive policies to reduce obesity prevalence. On the other hand, having information about this relationship may be important to avoid the perpetuation of intergenerational income inequality. Suppose, for example, that children from poor households are more likely to be obese (Laitinen et al., 2001), and obesity has a negative effect on earnings (Cawley, 2004). In this case, obesity can generate an income state dependence phenomenon in which current parents' income affects children' future earnings through (partially) the effect on the BMI of them[3].

Although the literature on BMI and obesity and socioeconomic status (SES) has been extended considerably since the seminal review by Sobal and Stunkard (1989), the main findings of these authors seem to remain valid. In a recent survey, Ball and Crawford (2004) find that in developed countries there is a negative relationship between BMI and socioeconomic status among women, but the relationship is not clear among men and children. However, one of the main problems of this huge literature --more than 175 papers are reviewed in those two studies-- is that, as far as I am concerned, there is no work providing comparable country results: the differences of each study in the

[3] Although this may only explain a very small part of the intergenerational transmission, this has not been quantified by any previous study. It may be also important to consider the correlation between parents' socioeconomic status and children socioeconomic status (McClendon, 1976; Rosenfeld, 1978) and the correlation between obesity of parents and obesity of children (Garn et al., 1981).

methodology, in the measure of SES, or in the data collection procedure can lead to misleading conclusions (Sobal and Stunkard, 1989)[4].

This paper offers three main contributions on the literature about BMI and SES. Firstly, using the European Community Household Panel (ECHP), which was designed precisely to provide comparable data among panel countries', I am able to overcome the difficulties pointed out by Sobal and Stunkard. The ECHP allows me not only to analyze this relationship among ten European countries, but also over the period 1998-2001. This basically means that I am able to deal with the largest, most recent, complete, and comparable international micro data set, and hence to provide new and comparable estimates of the SES and BMI relationship. Secondly, I develop an extensive descriptive analysis applying both parametric (specifically, Ordinary Least Squares regression) and semi-parametric (specifically, Quantile regression) techniques. This allows me to provide the most reliable and robust description of the actual income gradient in BMI in European countries available at this time. Finally, I attempt to provide an estimate of the causal effect of income on BMI based on an Instrumental Variables regression approach, making use of a well-known potential source of exogenous variation in household income, namely whether the household has received a inheritance, gift or some lottery winnings worth 2000 Euro or more. Thus, the present work does offer crucial information for fighting efficiently against the worldwide epidemic of this new century.

[4] Some of the recent studies about SES and obesity, overweight, or BMI in some of the countries analyzed in the present work are: Artalejo et al. (2002) in Spain, Klumbiene et al. (2004) in Finland, Manios et al. (2005) in Greece, Molarius (2003) in Sweden, Celi et al. (2003) in Italy, and Santos and Barros (2003) in Portugal.

The structure of the paper is as follows. In section 2, I describe the data and the variables used in my analysis. Section 3 presents the methodology, the descriptive analysis, and the temptative causal analysis. Finally, section 4 discusses the results and suggests further lines for future research.

2. Description of the Data

2.1. The Data Set

The data used in this paper come from the European Community Household Panel (ECHP). This is a survey based on a standardized questionnaire that involves annual interviewing of a representative panel of households and individuals in each country, covering a wide range of topics: income, health, education, housing, demographics and employment characteristics, etc. Although the total duration of the ECHP was 8 years, running from 1994 to 2001, a key variable in this work (namely the BMI) is only available since 1998. Moreover, the BMI is not reported in 5 countries: England, France, Germany, Luxembourg, and The Netherlands. Hence, the remaining countries in my analysis are: Austria, Belgium, Denmark, Finland, Greece, Ireland, Italy, Portugal, Spain, and Sweden. For Finland and Sweden, the BMI is only available from 1999 onwards.

As I mentioned in the introduction, the ECHP is a unique source of information for the purposes of this paper. Firstly, it covers a multi-dimensional range of topics simultaneously. Secondly, its standardized methodology and procedures yield comparable information across countries. And thirdly, its longitudinal design allows me to control for individual heterogeneity using individual fixed effects.

2.2. The Variables

The dependent variable in my analysis is the natural logarithm of self-reported BMI, which is constructed using self-reported height and weight measures; hence, it is important to recognize that it is potentially measured with error. In fact, it is well known that self-reported anthropometric variables contain measurement error with heavier persons more likely to underreport their weight. If we had an alternative data set with an available BMI measure, we could try to correct for the measurement error in self-reported BMI, for example, using the technique described in Cawley (2000). Unfortunately, I have no other available data set. However, using self-reported BMI does not seem to be of critical relevance. First of all, if self-reported BMI is measured with classical measurement error, the only caveat is that my estimates will be less precise than using the actual BMI. Secondly, according to Boström and Diderichsen (1997), using BMI as a continuous variable will probably have a small effect on the analysis. The problem would arise if we were using categorical variables based on self-reported BMI. In this case, and following Boström and Diderichsen, we should use some kind of corrective technique, because overweight people tend to underreport their BMI, and thin people do the reverse. Finally, there is no clear socioeconomic pattern in this measurement error. For example, Boström and Diderichsen found more error in lower socioeconomic groups, while Niedhammer et al. (2000) found more error in higher socioeconomic groups. It is also worth noting that Cawley (2000) reports that his findings do not change whether he corrects or not for the measurement error in self-reported BMI.

The most relevant explanatory variable of the present analysis is the natural logarithm of income, although I will use other covariates in order to control for confounding factors. The measure of income chosen in this study is the total net annual household income in the year prior to the survey adjusted by the modified-OECD equivalence scale and deflated by the consumer price index (CPI) in each country[5]. This is done to obtain an accurate measure of the total household income per household member in real terms and to reduce the potential simultaneity bias, since BMI can affect income. It is important to note that this is only a way to deal partially with the simultaneity bias, used, for example, by Elo and Preston (1996), and that it only works when individual fixed effects are not included in the regression. After this deflation, I compute the natural logarithm of total net deflated household income.

The socio-demographic controls used in my analysis are age and its square, to capture the well-documented biological life-cycle effect on BMI; the highest level of completed education, to capture the protective effect of education; marital status, to capture the role of marriage and dating markets in determining weight; smoking behavior, to capture the negative effect of smoking on weight; and health status, to capture the effects of health impairments that could affect BMI. Finally, I also include time fixed effects, to capture macro effects on the BMI at the country level; regional fixed effects, to capture

[5] The modified OECD equivalence scale establishes a value of one for the household head, 0.5 for other adults and 0.3 for those below 14 years old. For each country I use the general index CPI. The source of this index (except for Ireland) is Eurostat: http://www.europa.eu.int/comm/eurostat. For Ireland, the source is International Monetary Fund. I have adjusted all the CPI's to be in 2000 national currency for each country.

influences of regional constant characteristics; and time-by-region fixed effects, to account for regional characteristics that change over time and can affect BMI.

The definitions of these variables are as follows: education level is defined as three dummies, a dummy for third level completed (ISCED 5-7), a dummy for second level completed (ISCED 3), and a dummy for less than second level completed (ISCED 0-2); marital status is defined as five dummies, a dummy for married, for divorced, for separated, for widow, and for never married; smoking behavior is defined as five dummies: a dummy for each category (smoke daily, smoke occasionally, used smoke daily, used smoke occasionally, and never smoked); health status is defined as five dummies: a dummy for each level of self-reported health status (very good, good, fair, bad, and very bad); time fixed effects are dummies for each year; regional fixed effects are dummies for each region; and time-by-region fixed effects are the product of the interaction between time-dummies and regional dummies.

Finally, I ought to point out that I control for interview design effects using dummies for the month of interview, type of interview (1 if face-to-face, 0 otherwise), and dummies for the year of interview (that can differ from the year regarding the information asked). This is done to account for influences of month of interview on weight (e.g., after a period of vacation, people may tend to gain weight), incentives to underreport weight depending on whether the interviewer is present or not, and to reduce the bias due to recall problems (when the year of the interview is the subsequent with respect to the year about the question regards).

The sample for each country is restricted to people satisfying four basic requirements: age between 17 and 64 years old, not hampered in their daily activities by any chronic,

physical, or mental health problem, located in any percentile of the income distribution above the 1.5% percentile, and $10 \leqslant BMI \leqslant 60$. Table – 1 shows the basic descriptive statistics for three key variables: BMI, the natural logarithm of adjusted household income, and age.

[Insert Table – 1 about here]

3. Empirical Analysis

The main purpose of this paper is to describe the empirical BMI-income relationship in Europe, and to some extent to determine whether there is a causal relationship from income to BMI. For this reason, and as I described in the introduction, my analysis has two main parts: a rigorous description of this relation and a temptative causal inference analysis.

In the descriptive part, there are two well distinct parts. First, there is a parametric analysis, where I run Ordinary Least Squares (OLS) regressions. In the present case, OLS regressions provide estimates of the average response of BMI to a change in income. Moreover, since both the dependent variable and the main explanatory variables are in logarithms, OLS estimates are interpreted as elasticities of BMI with respect to income[6]. However, as recognized by Kan and Tsai (2004), this technique does not provide enough information to make an inference, for instance, about the effect of income on overweight or obesity, because depending on the part of the distribution I am estimating the response of BMI to income, the sign and the magnitude of the coefficient may have a completely

[6] Although correlations by themselves are not going to tell us this, this is the first step in the empirical process to get accurate estimates of the elasticity of BMI with respect to income.

different interpretation[7]. For this reason, and following these authors, I use an alternative approach, a semi-parametric one using Quantile (Q) regressions, due to Koenker and Basset (1978), which constitutes the second part of the descriptive analysis. Q regressions help me to explore the BMI-income relationship in different parts of the BMI distribution. Some of the most important advantages of using Q regression over the OLS technique, described in Buchinsky (1998), are the following: a) it allows characterizing the entire conditional distribution of the log(BMI) conditional on the covariates; b) the estimated marginal effects are not sensitive to outlier observations on the log(BMI); c) if the error term of our model is not normal, Q regression estimators may be more efficient than OLS estimators; and, d) it allows to estimate potential different marginal effects at different parts of the distribution.

In the causal inference part, I move to an Instrumental Variables (IV) framework in order to disentangle the causal effect of income on BMI from other confounding factors. I make use of a well-known potential source of exogenous variation in household income, namely whether the household has received an inheritance, gift or some lottery winnings worth 2000 Euro or more. Provided that this instrument is valid, these estimates can be interpreted as valid elasticities of BMI with respect to income. The validity of this instrument will be discussed in the IV regression section.

[7] The reader may ask why I do not use a discrete variable of different categories based on the continuous BMI variable to overcome this difficulty. Although this could be a possible choice, three main caveats would arise: (a) measurement error issues will have worse implications (see Boström and Diderichsen, 1997); (b) the cut-off points used to define each category are only referential, not definitive, as remarked by Kan and Tsai (2004); and (c) in order to estimate the income gradient in BMI, this possible solution would be obviously inappropriate.

It is worth noting that in the OLS and Q regressions I will add only a linear term in log(income). This is done for several reasons. Firstly, since income is mismeasured, the coefficients of higher-order polynomials will tend to be highly biased towards zero, assuming that the error is classical. Secondly, if I control for individual fixed effects, the attenuation bias can be worse, and even controlling for the bias due to omitted constant differences across individuals, the net bias can be lower or higher (Griliches, 1986; Hausman, 2001). Thirdly, using higher-order polynomials instead of a linear specification may have undesired effects, since the polynomial specification is sensible to outliers (Deaton, 2000), although one can always trim the data on income. Fourthly, if I was really interested in capturing all the features about the BMI-income relationship, several complementary techniques may be used, for example, moving to a Fourier expansion after the quadratic term (Eubank and Speckman, 1990) or using a Partially Linear Model (for a basic review of this model, see DiNardo and Tobias, 2001). Finally, in order to compare my descriptive results with the causal ones, I need to use a linear approach in the OLS (and Q) approach, otherwise the causal effect of log(income) is not identifiable, since there is only one potential valid instrument in my data set. Hence, we should forget some detailed features of the description analysis in order to make some progress in the causal inference one. In summary, my OLS and Q estimates ought to be understood as linear approximations to the true empirical-relationship, less sensible to outliers than the polynomial approach, and allowing the comparison of the OLS estimates (the best linear predictors) with the IV estimates (the linear causal estimates).

3.1. OLS Regressions

The results from OLS regressions of the determinants of the log(BMI) for women and men, summarized in Table – 2, show a general result: there is a negative relationship between BMI and income in the case of women, but a positive one for men. On the one hand, the fact that income and BMI are negatively related for women is a well-known fact in the literature on BMI and SES for the developed countries (Sobal and Stunkard, 1989). On the other hand, the existing literature does not shed light on the relationship in the case of men, finding mixed results, in my case, a positive relationship.

[Insert Table – 2 about here]

But, why is there an opposite relation between income and BMI for women and men? Perhaps, the best explanation for this result is captured in Sobal and Stunkard, quoting them: "*obesity is a severely stigmatized condition among women, and one of relative affective neutrality among men*" (p. 267, italics added). The reasons for this can be a found on the thinner ideal body shape for women due to cultural, social, and economic phenomena: for women thinness may be seen as a (complementary) good for more of their purposes than for those of men, and comparing benefits and costs of thinness, on average, for the former thinness is profitable, and for the latter is the reverse. Since it seems to be that men value physical attractiveness in women more than women value physical attractiveness in men, and women tend to identify attractiveness to thinness more than men, some plausible explanations may be social integration, marriage (and children), and/or getting a job. The first argument, social integration, reflects the fact that the concern about physical attractiveness or thinness is higher for those female of higher socioeconomic status (as reported in Sobal and Stunkard, 1989), may be because they

have less concerns than low socioeconomic status women. The second factor can be perfectly understood as women trying to maximize the probability of matching in the dating market. Here, the key point is that women tend to lose weight in order to satisfy the requirements on thinness demanded by men (may be because they want to get married or they desire to have children). Finally, another potential explanatory factor is the pressure from the labor market. In this case, women tend to adjust their weight to maximize the probability of being hired by an employer, provided that there is "physical discrimination" against women in the labor market. It is possible that this labor market factor is substituting the dating-marriage market factor due to the lower dependence of women on (potential) income's husband. In fact, those days, pressures from the demand side of the marriage-dating market against women (basically from men) may play a less important role relative to pressures from the demand side of the labor market (basically from firms or consumers): firms or consumers may demand thinness as an attribute for female workers. The possibility of the existence of "physical discrimination" against women should be carefully studied, since it might shed more light on the socioeconomic factors determining BMI. A part of this suggestion, OLS estimates suggest that women may consider thinness as a (complementary) good: the higher their income, the lower their BMI.

Are there differences in the relationships across countries? Although in my opinion this deserves a one case-by-case study, rather than a reduced form study, let me try present two simple observations. First, considering only the statistically significant relations, it seems to be the case that a geographical pattern for the female BMI-Income relationship emerges: in 3 out of 4 Southern European countries (Greece, Italy, Portugal, and Spain)

there is a negative relationship, while this ratio is only 1 out of 3 for the Scandinavian European countries (Denmark, Finland, and Sweden); in the rest of countries, which I cannot classify in any specific group (Austria, Belgium, and Ireland), in 2 out of 3 there is a negative relationship. Second, considering again only the statistically significant relations, Figure – 1 try to illustrate an alternative geographic pattern using a map of Europe: if I trace an imaginary black line over London, separating Europe in two big areas, one above London and the other below it, then I find that 5 out of 6 countries where there is a negative relation are below London (the relative southern part of Europe). These two observations can be followed by some immediate temptative questions, like the followings: Does the negative BMI-income relationship disappear as we move from the South to the North of Europe? Does this reflect a cultural phenomenon and/or different preferences? Or, simply, does this thought exercise make sense at all? Unfortunately, all these questions can only be assessed on a case-by-case basis.

[Insert Figure – 1 about here]

3.2. Q Regressions

Are the estimated elasticities of BMI with respect to income constant over the BMI distribution? This question is addressed here. The importance of the answer, as I explained before, is pointed out by Kan and Tsai (2004). Hence I proceed to explore the relationship in different parts of the conditional log(BMI) distribution using the quantile regression technique, again separately for women and men. Figures from 2 to 8 show the OLS and Q (Quantile) regression estimates of the coefficient of log(income) for women. Following Buchinski (1998), I choose the following quantiles: 0.1, 0.25, 0.5, 0.75, and 0.9. The choice of these quantiles responds to the information provided by these: the

bottom, the median, and the top of the distribution. Obviously, I can choose more quantiles, but then time requirements and computational issues become more demanding. I report the quantile estimates for the countries where I found a statistically significant linear negative relationship. If one look at them, it is clear that an interesting pattern emerges: for women, the effect of income on BMI increases with the quantile of the BMI. Moreover, notice that in all cases, the quantile regression estimates lie at some point outside the confidence intervals for the OLS estimates. Although formal testing of this hypothesis is discussed in Koenker and Machado (1999), following Koenker and Hallock (2001), the last observation suggests that the effect of log(income) may not be constant across the conditional distribution of the log(BMI). For example, looking at Figure -- 2, in Austria while the OLS elasticity of BMI with respect to family income is approximately --2%, the elasticity is --1% at the 10 percentile of the BMI distribution, --2% at the median, and --4% at the 90 percentile.

After looking carefully at figures from 2 to 7, there are some aspects that deserve particular attention: a) I get similar estimates in Italy and Spain, on the one hand, and in Austria and Belgium, on the other; b) The highest effect of income in BMI in the 90 percentile is found in Belgium (approximately --6.5%), and the lowest is in Spain (approximately --2%). Notice that if these were causal estimates, a possible policy to prevent (reduce) the prevalence of obesity (and anorexia) would be redistribute income from high income families to low income ones, since these prevalences are related negatively and positively with income, respectively.

[Insert Figures 2 – 7 about here]

The same analysis was done for men, but no clear pattern emerged: for men, there is no clear pattern in the effect of income on BMI with respect the quantile of the BMI. Moreover, in general, the quantile regression estimates lie inside the confidence intervals for the OLS estimates, suggesting that the effect of income is constant across the conditional distribution of the BMI. These results are available from the author upon request.

Hence, after analyzing the OLS and Q estimates for women and men, I find four main empirical results:

1. The relationship between BMI and income is different for women and men: there is a negative relationship in the case of women, and a positive one in the case of men.

2. In the case of women, an interesting geographical pattern is found: the income gradient in Body Mass Index seems to "disappear" as we move from the South to the North of Europe.

3. The relationship does not seem to be constant over the BMI distribution for women; for men, the relationship seems to be constant.

4. The relationship for women increases in absolute value as we move in ascending quantile order: the higher the BMI, the higher the effect of income on it.

The first result --which I only mention because it was discussed in the previous section-- supports the previous empirical evidence about the negative relationship between BMI and income for women. For men, the evidence until the present work was mixed. Here, I report a positive relationship for them.

The second result, which is merely suggestive, is that the income gradient in BMI may tend to be less important (or to disappear to some extent) when moving from the South to the North of Europe. This may represent differences in cultural-esthetic factors regarding the attractiveness of women, differences in preferences among men for thinness or not, differences in the kind of social and labor market institutions, differences in the relative prices of food, etc. However, given that it is very difficult to account for different geographical patterns (e.g., overweight and obesity levels among children in Southern Europe tend to be higher than their Northern European counterparts as the traditional Mediterranean diet gives way to more processed foods rich in fat, sugar and salt (IOTF, 2005)), this will deserve a one case-by-case study.

The third and fourth observations are linked. It seems that the relationship is not constant for women, but constant for men: for women, the higher their BMI, the higher the effect of income on it. This finding is quite interesting. If the Quantile elasticities provided in the present work had a causal meaning, then it would be possible to redistribute income from the richest women to the poorest in order to reduce the prevalence of obesity, and at the same time, reducing the prevalence of Anorexia (a mental disorder affecting basically young women from high SES).

As we can see, a descriptive analysis provides useful insights into the BMI-income relationship and to think about different conceptual and theoretical models that can shed light on the socioeconomic factors determining the BMI. However, a descriptive analysis has an important limitation: it does not tell much about causality and public policy implications. All the results shown until the moment tell us nothing about the causality of income on BMI by themselves. In order to infer causality from income to BMI, income

should be randomly assigned across population. This would assure that my previous estimates are not contaminated by unobserved factors (individual, familiar, etc.) that are correlated with income, and at the same time are determinants of the BMI by themselves. In fact, once I control for individual fixed effects, no clear relation emerges, and all of the described relations disappear. These estimates, although not presented in the paper, are available from the author upon request. Hence, the estimated BMI-income elasticities computed until the moment cannot be considered (true elasticities) in causal terms, for example, in order to make a benefit-cost analysis.

Although individual fixed effects estimation leads to different estimates than the presented so far, it is important to highlight that controlling for individual fixed effects has several caveats. First of all, it is a very specific way to control for explanatory factors that we do not observe: particular characteristics of the individuals that remain constant over time and that have an additively effect on the BMI. Second, it does not deal with the fact that BMI can affect income (simultaneity bias). Third, notice that individual fixed effect estimation suffers from an important variance-bias trade-off: imprecision versus consistency. On the one hand, a necessary condition to get consistent estimates trough fixed effect estimation is that the only source of endogeneity comes from unobservable individual factors that are constant over the period of analysis. This can make sense in a short period of time (like the one considered here, 3-4 year) for an adult person (like those consider in the study). But, on the other hand, the fact that the period of time is short (making plausible the assumption of the fixed effect) makes very difficult to find enough variation in income in the period under study. This implies that the estimates will be very imprecise, i.e., without statistic significance and, even if they are consistent, they

can be further from the truth than the inconsistent OLS estimates (Deaton, 2000). Fourthly, this last problem gets worse because of the measurement error in income. Fixed effects estimation not only does not deal with the problem of measurement error in income, but moreover it exacerbates this. Finally, consistent estimation using the fixed effects technique requires that the explanatory factors are strictly exogenous (i.e., uncorrelated with the error term, not only contemporaneously, but for all leads and lags). Thus, it is urgent to move to another strategy in order to overcome these pitfalls and to try to disentangle the causal effect of income on BMI from potential unobserved confounding factors, simultaneity bias, measurement error, etc.

3.3. IV Regressions

IV regression is a well-known and commonly used technique. In the present work, an instrument is defined to be a variable that is correlated with household income but uncorrelated with the unobserved determinants of the BMI that are correlated with income. This definition implicitly specifies the two conditions a (valid) instrument must satisfy: (a) the exogeneity condition (the instrument must be uncorrelated with the unobserved determinants of the BMI), and (b) the relevance condition (the instrument must be [enough] partially correlated with income), see Wooldridge (2001). In my context, and as clearly exposed by Angrist and Krueger (2001), the logic of the IV regression consists in using only the part of the variation in income that is correlated with the instrument (b) --and uncorrelated with the unobserved determinants of the BMI by assumption (a)-- to identify the causal effect of income on BMI. On the one hand, the exogeneity condition must be based on a good theoretical reason, (because) this is not

testable. On the other hand, the relevance condition must be based on a well-understood reason, and it must satisfy what I call "the good luck condition": after making the theoretical argument, the sample correlation must be high enough. Otherwise, the instrument is weak, and the IV estimate, its confidence interval, and the hypothesis testing are unreliable. According to Stock et al. (2002), a useful rule of thumb is to think that our instrument is probably weak when the t-statistic for the instrument in the first stage regression is less than $\sqrt{10}$.

What can be a source of exogenous variation in income? For example, it seems that receiving a gift or winning a lottery can be an exogenous source of income, as suggested by Imbens et al. (2001). Recently, Lindahl (2005) uses lottery prices as a source of exogenous variation in income to identify its causal effect on different health outcomes in Sweden: the idea is that winning a lottery, provided that people spend the same in each play, is totally random. Even in the more realistic case that different people spend different quantity of money in lottery, these differences should be too large in order to make an important differential in the probability of winning. Although not impossible, I do not think this is the case. Nevertheless, this is an empirical question that should be addressed in future work. Hence, in principle, winning a lottery is correlated with income, but is uncorrelated with other characteristics affecting BMI. Thus, winning or not a lottery can be considered a valid instrument. However, if I used only a lottery price as a source of exogenous variation in income, then I would be identifying the causal effect of income on BMI for those who play lotteries. On the one hand, if there were systematic differences between the group of players and non-players on other characteristics affecting the BMI, my estimate would not have a causal interpretation for all the

population, but only for those who play lotteries. But, on the other hand, if I am able to add another source of exogenous variation independent of the previous one, then it seems to be plausible that this mixed instrument can offer a more reliable causal estimate for the population as a whole. This is the main improvement over the previous IV strategies based only on lottery prizes. The argument can be made in the following heuristic way: Suppose we have two sources of exogeneity, prize from lottery *A* and prize from lottery *B*. Suppose also that the population is divided into two groups, those who play only lottery *A*, and those who play only lottery *B*. In that case, an instrument C_i identifies the causal effect of income on BMI for the population as a whole, where $C_i = I_i(\textit{winning lottery } A) + I_i(\textit{winning lottery } B)$, where I_i is the indicator function for individual *i* (equals 1 if the argument inside the parenthesis is satisfied). More specifically, in the present case, I will use an indicator variable whether the household received (last year) an inheritance, gift, or lottery winnings worth 2000 Euro or more. The fact that this variable is aggregating these different categories solves a problem that, otherwise, the applied econometrician ought to solve by constructing a variable aggregating different sources of income exogeneity. This is in fact, what I truly believe a potential improvement on the instrument used by Lindahl (2005)[8]. However, this strategy comes at a potential cost given our data set restrictions: for example, the fact that a person inherits something can be related with depression (health) if their parents die, and this person also can start to overeat. In this case, the exogeneity condition would be compromised.

Until here I have been discussing the properties that my suggested instrument must satisfy, now I proceed to analyze some of its empirical features, whether it satisfies the

[8] Paradoxically, the only country of my analysis without data for the mixture variable is Sweden.

relevance condition (recall, the only testable condition), and if the mixture is indeed like the rest of the population, at least in observable relevant terms. Looking at the fraction of people affected by the instrument, Table -- 3 shows the percentages of people affected by the instrument. Knowledge about the fraction of individuals affected by the instrument is crucial to understand my IV estimates and assess their reliability. This is an easy way to see the (exogenous) variation of income that IV regression uses to identify the causal effect of income on BMI. In experimental language, this is the fraction of people used as the "treatment" group, and its complementary is the fraction used as the "control" group.

[Insert Table – 3 about here]

After looking at Table -- 3, some concerns arise. As one may anticipate, the fraction of people affected by the instrument is, in general, very low (less than 1.5%). However, there are two countries where this fraction is above 5%: Finland and Denmark. It is important to take into account this information in order to give a coherent interpretation of my IV estimates.

It is a well-known fact, although sometimes not taken seriously into account, that if the proposed instrument is weak, the IV estimates will tend to be biased towards the OLS estimates. Using the previously cited rule of thumb about instrument weakness discussed previously for women and men separately, I find that, for women, in 4 out of 9 countries, there is evidence against instrument weakness, so I will only analyze the IV estimates for these 4 countries (Austria, Denmark, Finland, and Italy), where --at least from a relevance condition viewpoint-- my IV estimates should be reliable. In the case of men, only in 2 out of 9 countries, there is evidence against instrument weakness according to

both specifications; hence, for men, I will only analyze the IV estimates corresponding to these 2 countries: Finland and Italy.

Taking together these 2 empirical observations, it seems logical that the most reliable IV estimates are those for Denmark and Finland. Moreover, according to the comparison of people's characteristics depending on whether they are affected or not by the instrument, see Table – A in the Appendix, the mixture seems to be indeed like the rest of the population, what is in favor of my previous heuristic argument. I cannot analyze the potential improvement offered by this mixed variable over the lottery prize indicator, since the decomposition between each component of the mixture is not available in my data set.

Table – 4 shows the IV estimates (Two-Stage Least Squares). The only statistically significant estimates are found in Denmark (for women), in Finland (for men), and Italy (for women). Moreover, all these estimates are negative. In Denmark, the estimated BMI-income elasticity for women is between -16.9% and -15.5% depending on the specification chosen, and these are statistically significant at the 5% and 10% levels respectively. In the case of Finland, the estimates are between -18.2% and -32.3%, but only the first is statistically significant (10%). Finally, for Italy, the elasticities are between -11.5% and -11.2%, and again only the first is statistically significant (10%). If someone compares all these estimates with the previous OLS estimates, it is clear that the IV estimates seem to be too big. This fact makes me to be aware about giving too numerical importance to these estimates. Although we cannot reject the possibility that we are estimating a causal effect for a particular group of the population, two main

qualitative aspects that should be stressed: first, no positive statistically significant relation emerges, and second, the negative relationship is larger than before.

[Insert Table – 4 about here]

The evidence presented in the present work, while suggestive of a negative causal effect of income on BMI, is by no means conclusive. It is unlikely to persuade someone whose priors are strongly against the use of IV to identify causal effects. However, it is worth noting that the identification of the causal effect for these 3 countries is not by chance. In the case of Denmark, and Finland, the identification comes from a relatively large fraction of people affected by the instrument compared with the other countries (10% and between 5 and 6%, respectively) and a large t-statistic (higher than 4.5, and 4, respectively), while in the case of Italy this probably comes from its large t-statistic (higher than 5.3) and its huge large sample (approximately 20,000 observations) compared with Denmark and Finland (less than 5,000 observations). For the rest of the countries, none of these conditions are satisfied: small fractions of people affected by the instrument (in most of the case, 1% or so), and low (high) t-statistics with middle or smaller samples than Italy. Hence, my identification strategy is more likely to be close to a "quasi-experiment" than to a "lottery", i.e., by chance identification seems to be satisfactory discarded.

To finish I would like to mention some points regarding IV estimates that, in general, and in this particular case, should be taken into account:

1. The IV strategy solves the problem of the classical measurement error. If measurement error has a more general structure, for example multiplicative measurement error, consistency of IV estimates is not necessarily guaranteed. Identification in general measurement error specifications is currently a hot topic in Econometric Theory. One possible way to deal with this situation is to use some semi-parametric technique, although other identification concerns are likely to arise. See for example Schennach (2004).

2. Second, like in any IV strategy, I cannot verify if the "treatment" and the "control" group of my mixture experiment are similar in their unobserved factors related with income and BMI. However, given the plausible exogeneity assumption of my instrument, and the similar characteristics of those affected by the instruments and those who are not affected, this problem does not seem to be too serious in the present case.

3. The sample corresponding to Denmark is a simple random sample, what makes me to be confident about the reported standard errors, and hence about the significance of the Denmark IV estimates. At the same time, in the rest of the countries, the sample design is so complex: not having controlled for strata and clusters could lead to underestimate the standard errors of my estimates. However, problems of codification, confidentiality and unavailability of these identifiers makes this correction task completely cumbersome (if not impossible), and I do not find any intelligent reason of why applying a bad correction would be better than no using any correction at all.

4.The small correlation of the instrument presented here with income for several countries can be fixed using an available additional discrete variable regarding the amount of the inheritance, prize, or lottery winning: 1 (under 10,000 Euro), 2 (between

10,000 and 50,000), and 3 (more than 50,000). A recodification of this variable is likely to solve the weakness of the instrument, at least in some of the samples. Furthermore, this may be complemented using limited-information maximum likelihood (LIML) or jackknife IV approaches. If anything, my econometric feeling is that the conclusions would be stronger.

5. Finally, it would be very interesting to extend the present analysis from the standard parametric IV framework to a semi-parametric one using IV-Quantile regression. This is desirable, not only because it is a straightforward mechanical extension, but because it will be very informative to determine the feasibility of the income distribution policy repeated over and over again along this work. However, conceptually this extension is not enough clear to me. What IV-Quantile regression is identifying and, more important, how the instrument's requirements in the Quantile framework are supposed to be understood, not only in this framework, but in general (see for example, Chernozhukov and Hansen, 2005) is a question that should be seriously analyzed.

4. Discussion

The present paper has shown the most accurate descriptive work about the BMI and income in Europe until the date, and the first serious attempt to find the potential causal effect of income on BMI. In the first part of the descriptive analysis, OLS estimates seem to support the previous empirical evidence about the negative relationship between BMI and income for women. For men, the evidence until the present work was mixed. Here, I report a positive relationship for men. Moreover, in the case of women, and considering only the statistically significant relationships, an interesting geographical pattern is found:

the income gradient in Body Mass Index seems to disappear as we move from the South to the North of Europe. In the second part of the descriptive analysis, using the Q regression technique, I find that the BMI-income relationship does not seem to be constant over the BMI distribution for women; for men, the relationship seems to be constant. In particular, the relationship for women increases in absolute value as we move in ascending quantile order: the higher the BMI, the higher the effect of income on it. This may be a quite interesting finding from a public policy point of view: if these quantile estimates had a causal interpretation, it would be possible to redistribute income from the richest women to the poorest ones in order to reduce the prevalence of obesity, and at the same time, reducing the prevalence of Anorexia (a mental disorder affecting basically young women from high SES). However, unobservable confounding factors (among other potential problems) lead to be critic with the causal interpretation of these estimates. For this reason, I decided to move to an IV regression analysis, making use of a potentially exogenous source of variation in income, to find whether there is causality from income to BMI. After analyzing the validity of my strategy, my IV estimates are considered to be reliable only in 2 out of 9 countries: Denmark and Finland. Interestingly, the IV estimates are statistically significant precisely for these two countries and Italy. This suggests that the identification of the causal effect is not by chance, and hence this supports (at least, indirectly) my identification strategy. Furthermore, the IV estimates are negative and higher, in absolute value, than the OLS estimates. Since these are too big, considering these seriously from a quantitative point of view can be demanding too much. It cannot be discarded that the estimated effect is the effect of income on BMI for poor people. Nevertheless, there are two main qualitative aspects of my IV estimates that

should be stressed: first, only negative statistically significant relations emerge, and second, these are larger than before. Although this is a small piece of evidence, it seems to be the best available evidence in favor of income having a negative causal effect on BMI for women.

The present work opens new lines for further research. First of all, it is urgent to find new sources of exogenous variation in income to corroborate the main finding of the present work: for women, income has a negative effect on BMI. If this is corroborated, and taking into account that not only for Anorexia but also for Obesity female prevalences are higher than those of men, income can be thought as being a potential protective factor against obesity and, at the same time, a risk factor for anorexia. For this reason, and secondly, it will be very interesting to reproduce the Q regression analysis done in the present work instrumenting income, after having achieved previously a better understanding about what are the conceptual requirements of the identification strategy in this particular case. Finally, although this is the first serious attempt to disentangle the causal effect of income on BMI in European countries, no serious analysis have been done to disentangle the causal effect of BMI on income (in particular wages) for these same countries. This study should be promptly done, and in fact, the author has started to work on it.

Table – 1. Sample Descriptive Statistics: Means and (Standard Deviations)

	Austria		**Belgium**		**Denmark**		**Finland**		**Greece**	
Variables	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
BMI	23.8 (4.0)	25.4 (3.5)	23.6 (4.3)	25.0 (3.8)	23.8 (4.0)	25.2 (3.5)	24.3 (4.2)	25.5 (3.6)	24.3 (3.9)	25.9 (3.4)
log(Adjusted Household Income)	7.7 (0.4)	7.7 (0.4)	8.8 (0.5)	8.9 (0.5)	7.4 (0.4)	7.4 (0.4)	6.8 (0.5)	6.9 (0.5)	10.0 (0.6)	10.1 (0.6)
Age	39.8 (13.4)	38.9 (13.4)	39.8 (12.3)	39.7 (12.4)	40.3 (12.3)	40.5 (12.4)	39.2 (12.9)	39.4 (12.8)	39.4 (13.4)	39.5 (13.5)
Number of Observations	7,501	7,338	5,478	5,018	4,422	4,717	4,850	4,546	11,621	11,109
	Ireland		**Italy**		**Portugal**		**Spain**		**Sweden**	
Variables	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
BMI	23.9 (4.1)	25.3 (3.4)	23.1 (3.7)	25.0 (3.4)	24.3 (3.9)	25.4 (3.3)	23.7 (4.1)	25.6 (3.6)	23.9 (3.6)	25.3 (3.2)
log(Adjusted Household Income)	4.6 (0.5)	4.7 (0.5)	5.2 (0.6)	5.2 (0.6)	9.4 (0.6)	9.4 (0.6)	9.5 (0.6)	9.6 (0.6)	7.3 (0.5)	7.3 (0.5)
Age	38.0 (13.7)	37.8 (13.8)	39.1 (13.3)	38.9 (13.4)	38.4 (13.7)	37.8 (13.7)	37.7 (13.1)	37.2 (13.3)	41.0 (11.8)	41.4 (11.8)
Number of Observations	5,640	5,442	19,861	19,723	11,976	11,923	14,552	14,598	4,617	4,659

Table – 2. Marginal Effect of the log(adjusted household income) on the log(BMI)

	Women		Men	
	OLS A	**OLS** B	**OLS** A	**OLS** B
AUSTRIA	-0.032***	-0.023***	-0.001	-0.009
	(0.008)	(0.008)	(0.007)	(0.007)
	[7,695]	[7,501]	[7,516]	[7,338]
BELGIUM	-0.047***	-0.036***	0.006	0.023***
	(0.007)	(0.007)	(0.007)	(0.008)
	[5,648]	[5,478]	[5,154]	[5,018]
DENMARK	-0.012	-0.008	0.004	0.013
	(0.012)	(0.012)	(0.009)	(0.009)
	[4,469]	[4,422]	[4,768]	[4,717]
FINLAND	-0.028***	-0.019***	0.010	0.017**
	(0.009)	(0.010)	(0.008)	(0.008)
	[5,080]	[4,850]	[5,259]	[5,080]
GREECE	0.018***	-0.004	0.003	0.007**
	(0.005)	(0.008)	(0.003)	(0.003)
	[11,658]	[11,621]	[11,122]	[11,109]
IRELAND	-0.010	-0.005	0.024***	0.028***
	(0.009)	(0.009)	(0.007)	(0.008)
	[5,800]	[5,640]	[5,805]	[5,653]
ITALY	-0.025***	0.010**	-0.003	0.006*
	(0.003)	(0.003)	(0.003)	(0.003)
	[20,042]	[19,861]	[19,852]	[19,723]
PORTUGAL	-0.042***	-0.020***	0.001	0.011**
	(0.007)	(0.006)	(0.005)	(0.005)
	[11,977]	[11,976]	[11,926]	[11,923]
SPAIN	-0.031***	0.013***	-0.001	0.004
	(0.004)	(0.004)	(0.004)	(0.004)
	[14,617]	[14,552]	[14,638]	[14,598]
SWEDEN	-0.001	0.004	0.013***	0.019***
	(0.004)	(0.004)	(0.004)	(0.004)
	[4,674]	[4,617]	[4,731]	[4,659]

Note: Columns designated with an A control for age, age squared, regional dummies, year dummies and region-by-year dummies, while columns designated with a B control for these variables and moreover educational dummies, marital status dummies, smoking behavior dummies and health dummies. Robust standard errors allowing for correlated observations for the same individual over time are reported in parentheses and the number of observations is reported in brackets. These regressions use the base weights designed for longitudinal analysis in the ECHP. People who declare being hampered in their daily activities by some physical or mental health problem, illness or disability are excluded from the sample. Moreover, the 1.5% lower tail of the distribution of adjusted household income is also excluded to avoid the effect of outliers, and also the observations with a BMI lower than 10 or higher than 60. The age of the people included in the sample is between 17 and 64, and the period of time covered is 1998-2001. Adjusted household income by modified OECD equivalence scale, and deflated by national CPI. All the regressions include controls for interview-design effects.

*** Significant at the 1%, ** Significant at the 5%, * Significant at the 10%.

Figure – 1. Map of Europe

Source: The General Libraries, The University of Texas at Austin.

Figures 2 – 7. Marginal Effect of the log(adjusted household income) on the log(BMI) by OLS and Q regressions for women.

Figure – 2. Austria, 1998-2001.

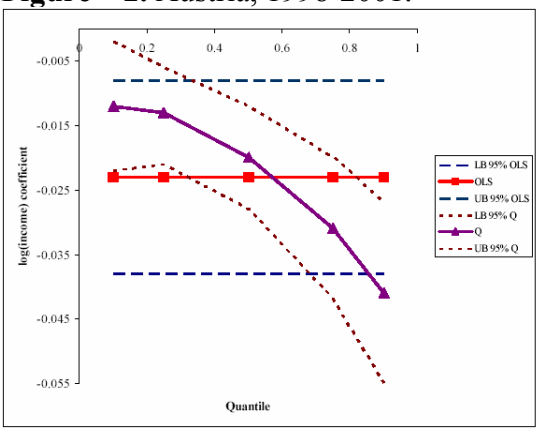


Figure – 3. Belgium, 1998-2001.

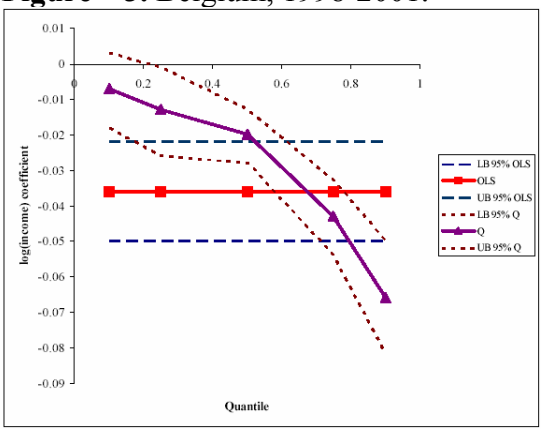


Figure – 4. Finland, 1999-2001.

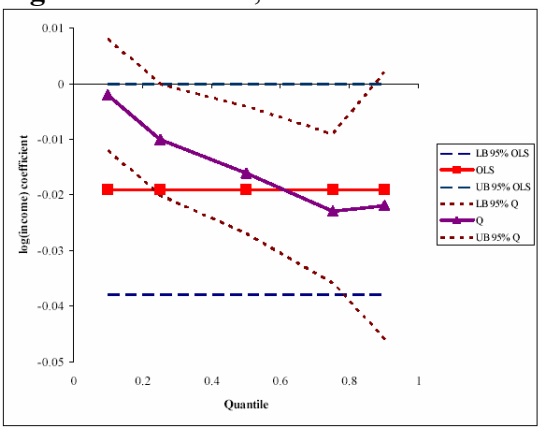


Figure – 5. Italy, 1998-2001.

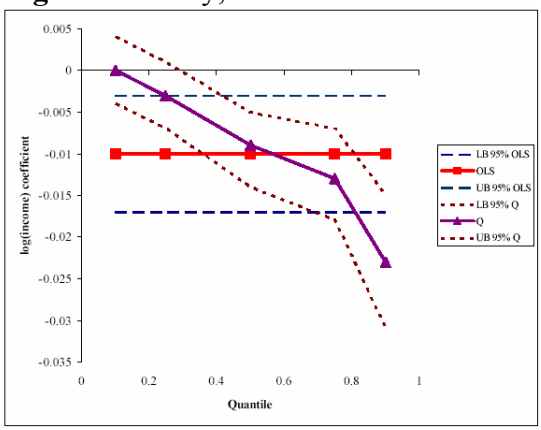


Figure – 6. Austria, 1998-2001.

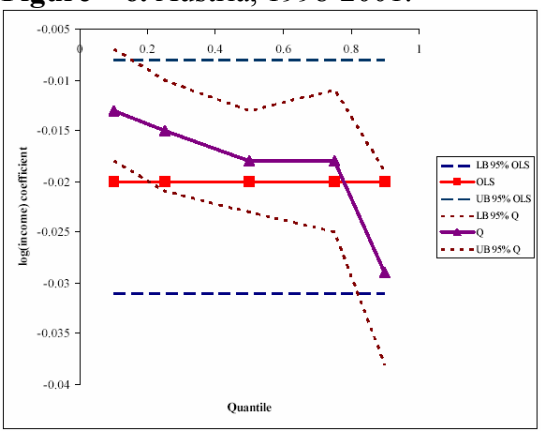
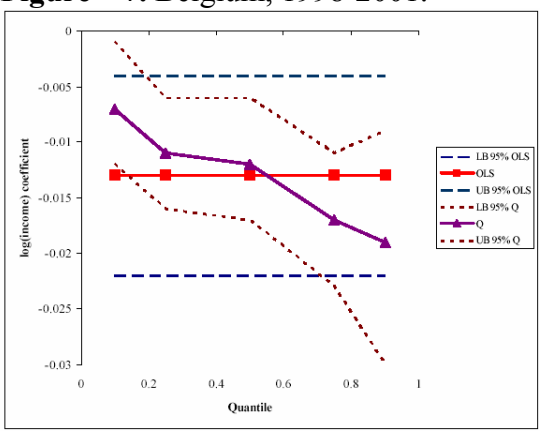


Figure – 7. Belgium, 1998-2001.



UB = Upper Bound, LB= Lower Bound. The confidence intervals for the Quantile estimates are obtained via the method of normal approximation after bootstrapping (50 replications because of time reasons). Obviously, this is only a suggestive confidence interval: the number of replications should be as high as possible (for example, Tsai (2004) or more).

Table – 3. People Affected by the Instrument (%).

	Women	Men
AUSTRIA	1	1
BELGIUM	4	4
DENMARK	10	10
FINLAND	6	5
GREECE	1	1
IRELAND	1.5	1.5
ITALY	1	1
PORTUGAL	0.7	0.7
SPAIN	0.1	1.5
SWEDEN	--	--

Table – 4. Marginal Effect of the log(adjusted household income) on the log(BMI)

	Women		Men	
	IV A	**IV** B	**IV** A	**IV** B
AUSTRIA	0.104	0.143	-0.183	-0.247
	(0.098)	(0.115)	(0.118)	(0.235)
	[7,685]	[7,492]	[7,522]	[7,336]
	{3.55}	{3.19}	{2.14}	{1.29}
BELGIUM	0.060	0.084	-0.001	0.203
	(0.256)	(0.283)	(0.165)	(0.443)
	[5,636]	[5,466]	[5,144]	[5,009]
	{1.39}	{1.21}	{2.02}	{0.74}
DENMARK	-0.169**	-0.155**	-0.003	0.094
	(0.086)	(0.085)	(0.107)	(0.148)
	[4,459]	[4,412]	[4,755]	[4,706]
	{4.53}	{4.54}	{3.41}	{2.68}
FINLAND	-0.027	0.044	-0.182*	-0.323
	(0.105)	(0.145)	(0.097)	(0.029)
	[5,080]	[4,850]	[5,259]	[5,080]
	{4.39}	{3.27}	{4.00}	{2.20}
GREECE	-0.148	-0.099	0.201	0.196
	(0.153)	(0.135)	(0.126)	(0.139)
	[11,658]	[11,621]	[11,122]	[11,109]
	{1.95}	{2.11}	{2.53}	{2.37}
IRELAND	-0.137	-0.161	-0.044	-0.041
	(0.103)	(0.143)	(0.101)	(0.137)
	[5,686]	[5,537]	[5,678]	[5,538]
	{3.12}	{2.38}	{4.00}	{2.58}
ITALY	-0.115*	-0.112	0.044	0.085
	(0.067)	(0.076)	(0.062)	(0.076)
	[20,024]	[19,846]	[19,836]	[19,707]
	{5.37}	{5.51}	{4.02}	{3.58}
PORTUGAL	0.048	0.067	-0.073	-0.102
	(0.110)	(0.102)	(0.080)	(0.176)
	[11,975]	[11,974]	[11,925]	[11,922]
	{1.84}	{1.71}	{1.70}	{0.89}
SPAIN	-0.018	0.035	0.070	0.072
	(0.088)	(0.141)	(0.103)	(0.119)
	[14,614]	[14,549]	[14,637]	[14,597]
	{3.14}	{1.85}	{2.07}	{1.86}

Note: See Table – 2. Between { } I report the first stage t-statistic for instrument relevance.

Table – A. Affected and Unaffected by the Instrument Comparison

DENMARK

WOMEN unaffected by the instrument

Variable	Obs	Mean	Std. Dev.	Min	Max
BMI	3973	23.80856	3.995017	12.5	57.14286
log(adjusted hh income)	3973	7.361959	.3771868	6.207491	9.563956
AGE	3973	40.19179	12.3054	17	64
ISCED 5-7	3973	.298515	.4576642	0	1
ISCED 3	3973	.5132142	.4998883	0	1
ISCED 0-2	3973	.1882708	.3909775	0	1
MARRIED	3973	.5932545	.4912885	0	1
SEPARATED	3973	.0108231	.1034824	0	1
DIVORCED	3973	.0855776	.2797746	0	1
WIDOWED	3973	.0213944	.1447134	0	1
NEVER MARRIED	3973	.2889504	.4533319	0	1
SMOKE DAILY	3973	.3146237	.4644243	0	1
SMOKE OCCASIONALLY	3973	.0322175	.1765994	0	1
USED SMOKE DAILY	3973	.1701485	.3758105	0	1
USED SMOKE OCCASIONALLY	3973	.0465643	.2107303	0	1
NEVER SMOKED	3973	.436446	.4960069	0	1
VERY GOOD HEALTH	3973	.5620438	.4961981	0	1
GOOD HEALTH	3973	.3498616	.4769861	0	1
FAIR HEALTH	3973	.0812988	.2733278	0	1
BAD HEALTH	3973	.0055374	.0742166	0	1
VERY BAD HEALTH	3973	.0012585	.0354574	0	1

WOMEN affected by the instrument

Variable	Obs	Mean	Std. Dev.	Min	Max
BMI	439	23.41208	3.605964	16.02307	36.06484
log(adjusted hh income)	439	7.50232	.4407514	6.202906	9.576221
AGE	439	41.30296	12.55206	17	64
ISCED 5-7	439	.3348519	.4724771	0	1
ISCED 3	439	.4624146	.4991542	0	1
ISCED 0-2	439	.2027335	.4024943	0	1
MARRIED	439	.6355353	.4818288	0	1
SEPARATED	439	.0273349	.1632433	0	1
DIVORCED	439	.0751708	.2639676	0	1
WIDOWED	439	.0182232	.1339104	0	1
NEVER MARRIED	439	.2437358	.4298249	0	1
SMOKE DAILY	439	.3485194	.4770451	0	1
SMOKE OCCASIONALLY	439	.0455581	.2087626	0	1
USED SMOKE DAILY	439	.1389522	.3462912	0	1
USED SMOKE OCCASIONALLY	439	.0569476	.2320069	0	1
NEVER SMOKED	439	.4100228	.4923986	0	1
VERY GOOD HEALTH	439	.571754	.4953891	0	1
GOOD HEALTH	439	.3485194	.4770451	0	1
FAIR HEALTH	439	.0683371	.2526114	0	1
BAD HEALTH	439	.0045558	.0674196	0	1
VERY BAD HEALTH	439	.0068337	.0824773	0	1

FINLAND

MEN unaffected by the instrument

Variable	Obs	Mean	Std. Dev.	Min	Max
BMI	4308	25.55326	3.656779	17.04033	50.27291
log(adjusted hh income)	4308	6.845664	.4892364	5.200981	9.87709
AGE	4308	39.30037	12.7998	17	64
ISCED 5-7	4308	.2938719	.4555868	0	1
ISCED 3	4308	.4830548	.4997708	0	1
ISCED 0-2	4308	.2230734	.4163555	0	1
MARRIED	4308	.5561746	.4968921	0	1
SEPARATED	4308	.0051068	.0712873	0	1
DIVORCED	4308	.0603528	.238167	0	1
WIDOWED	4308	.0085887	.092287	0	1
NEVER MARRIED	4308	.3697772	.4828003	0	1
SMOKE DAILY	4308	.2792479	.4486817	0	1
SMOKE OCCASIONALLY	4308	.0506035	.2192121	0	1
USED SMOKE DAILY	4308	.198468	.3988927	0	1
USED SMOKE OCCASIONALLY	4308	.025766	.1584549	0	1
NEVER SMOKED	4308	.4459146	.4971239	0	1
VERY GOOD HEALTH	4308	.2595172	.4384206	0	1
GOOD HEALTH	4308	.5629062	.4960846	0	1
FAIR HEALTH	4308	.1740947	.3792349	0	1
BAD HEALTH	4308	.0034819	.0589116	0	1
VERY BAD HEALTH	4308	0	0	0	0

MEN affected by the instrument

Variable	Obs	Mean	Std. Dev.	Min	Max
BMI	238	25.23409	3.294552	17.31912	37.03704
log(adjusted hh income)	238	6.979974	.4338621	5.349916	8.143329
AGE	238	40.34034	12.34412	17	64
ISCED 5-7	238	.4537815	.4989085	0	1
ISCED 3	238	.3991597	.4907578	0	1
ISCED 0-2	238	.1470588	.3549109	0	1
MARRIED	238	.6512605	.4775757	0	1
SEPARATED	238	0	0	0	0
DIVORCED	238	.0504202	.2192715	0	1
WIDOWED	238	.0042017	.0648204	0	1
NEVER MARRIED	238	.2941176	.4566054	0	1
SMOKE DAILY	238	.1890756	.3923939	0	1
SMOKE OCCASIONALLY	238	.0798319	.271604	0	1
USED SMOKE DAILY	238	.2689076	.4443262	0	1
USED SMOKE OCCASIONALLY	238	.0336134	.1806119	0	1
NEVER SMOKED	238	.4285714	.4959146	0	1
VERY GOOD HEALTH	238	.2563025	.4375109	0	1
GOOD HEALTH	238	.6092437	.4889482	0	1
FAIR HEALTH	238	.1302521	.3372899	0	1
BAD HEALTH	238	.0042017	.0648204	0	1
VERY BAD HEALTH	238	0	0	0	0

ITALY

WOMEN Unaffected by the instrument

Variable	Obs	Mean	Std. Dev.	Min	Max
BMI	19603	23.10814	3.735097	11.23002	59.52133
log(adjusted hh income)	19603	5.192145	.572844	3.203167	7.726253
AGE	19603	39.10116	13.27902	17	64
ISCED 5-7	19603	.0817222	.273948	0	1
ISCED 3	19603	.4183033	.4932931	0	1
ISCED 0-2	19603	.4999745	.5000128	0	1
MARRIED	19603	.6208744	.4851818	0	1
SEPARATED	19603	.0159669	.1253507	0	1
DIVORCED	19603	.0092843	.0959091	0	1
WIDOWED	19603	.0299444	.1704383	0	1
NEVER MARRIED	19603	.32393	.4679856	0	1
SMOKE DAILY	19603	.1610978	.3676305	0	1
SMOKE OCCASIONALLY	19603	.0703974	.2558221	0	1
USED SMOKE DAILY	19603	.0328011	.1781202	0	1
USED SMOKE OCCASIONALLY	19603	.0398408	.1955901	0	1
NEVER SMOKED	19603	.6958629	.4600527	0	1
VERY GOOD HEALTH	19603	.182166	.3859911	0	1
GOOD HEALTH	19603	.5187981	.4996592	0	1
FAIR HEALTH	19603	.2756721	.4468637	0	1
BAD HEALTH	19603	.0220374	.146809	0	1
VERY BAD HEALTH	19603	.0013263	.0363955	0	1

WOMEN Affected by the instrument

Variable	Obs	Mean	Std. Dev.	Min	Max
BMI	243	22.38379	3.557023	15.79431	40
log(adjusted hh income)	243	5.422987	.6402963	3.561127	7.26934
AGE	243	37.35802	12.72075	17	64
ISCED 5-7	243	.1358025	.3432858	0	1
ISCED 3	243	.4938272	.5009938	0	1
ISCED 0-2	243	.3703704	.4839006	0	1
MARRIED	243	.6255144	.4849888	0	1
SEPARATED	243	.0082305	.0905342	0	1
DIVORCED	243	.0123457	.110651	0	1
WIDOWED	243	.0205761	.1422534	0	1
NEVER MARRIED	243	.3333333	.4723775	0	1
SMOKE DAILY	243	.1728395	.3788889	0	1
SMOKE OCCASIONALLY	243	.0987654	.2989626	0	1
USED SMOKE DAILY	243	.037037	.1892424	0	1
USED SMOKE OCCASIONALLY	243	.0658436	.2485204	0	1
NEVER SMOKED	243	.6255144	.4849888	0	1
VERY GOOD HEALTH	243	.2345679	.424603	0	1
GOOD HEALTH	243	.4897119	.5009259	0	1
FAIR HEALTH	243	.2469136	.4321061	0	1
BAD HEALTH	243	.0288066	.1676078	0	1
VERY BAD HEALTH	243	0	0	0	0

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