ISSN 0143-4543

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Discussion Paper 2007-13
March 2007

Editor: Dr W David McCausland
www.abdn.ac.uk/business/

Do Economic Inequalities Harm Health? Evidence from Europe

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Abstract:

Until recently, there has been a consensus among empirical health economists that there is an association between income inequality and individual health, in line with Wilkinson's (1992) idea that the psychosocial effects of the former are detrimental to the latter. However, using US data, Mellor and Milyo (2002) (MM) found no evidence of such association and claimed that the previously reported results are statistical artefacts, arising from the use of aggregate data. This paper uses the European Community Household Panel (ECHP) to check the robustness of MM results. It replicates the MM methodology to assess the effect of country-level income inequality on individuals' health. It is shown that income inequality, whether measured at the regional or the national level, systematically harms individuals' health, regardless of their positions in the income distribution.

The results are also robust to a number of aspects MM do not account for. First, random effect models are estimated to account for unobserved heterogeneity. Second, self-assessed and objective measures of health status are also considered. Third, besides the traditional aggregate measures of income inequality, a further measure is constructed reflecting first, how unequal the distribution is and second the relative position of individuals in the income distribution of their own country.

JEL classification: I12, D63

Keywords: Income inequality, individual health status, Income Inequality Hypothesis

[1] We would like to thank Peter Dolton, Tor Eriksson, Claudio Lucifora, Panos Tsagloglou and participants to the ERMES seminar at the Université Panthéon-Assas (Paris 2) and to the IHEA conference in Bercelona for valuable discussions and comments. Financial support from the European Commission under grant QLK6-CT-2002-02292 for the SOCIOLD project is also gratefully acknowledged. The usual disclaimer applies.

1. Introduction:

During the last two decades, there has been a rapidly growing literature investigating the association between health and socio-economic inequalities (see Smith, 1999 and Skalli *et al*, 2005). Improving the understanding of the mechanics of this association is important for at least two reasons. First, as a large number of studies show, the relationship between health and socio-economic status is a complex one and this makes the identification of health determinants a difficult investigation (Adams *et al*, 2003). Second, the relevant policy authorities need a clear understanding of the mechanisms underlying the social health gradient in order to efficiently target the reduction of health inequalities among citizens.

Most of the literature relies on Grossman's (1972) model of health capital accumulation that provides an insight on how health capital is formed through investments in medical care and through health-related behaviour. One corollary of this model is that if socio-economic differences determine the propensity to invest in medical care and/or lifestyle behaviour, then they should also determine individuals' health. Hence, the main issue in empirical studies is to investigate whether socio-economic differences affect the various dimensions of individual health status. Noticeable studies on this issue are Hitiris & Posnett (1992) and Rhum (2000) who use state-level data and Martelin (1994), Everson *et al* (2002) and O'Reilly (2002) who rely on individual data. The evidence shows that social conditions are important determinants of health. Pincus *et al*, 1998 show that they are even more important than access to health care *per s*. Socio-economic factors found to affect health inequalities are income (Ecob and Davey Smith, 1999), occupational status indicators (Or, 2000), education (van Rossum *et a.*, 2000, Everson *et al*, 2002), genetic endowments (Smith and Kington, 1997), lifestyle factors (Or, 2000), past demographic history (Grundy and Holt, 2000) and marital status.

A number of authors have argued that income inequality in a society might also have an impact on its members' health through a variety of psycho-social factors (Wilkinson, 1992, 1995, 1996, Kaplan *et al*, 1996 and Kawachi *et al*, 1997). Wilkinson (1996) pointed out that '*It is now clear that the scale of income differences in a society is one of the most powerful determinants of health*'. Mellor and Milyo (1999) underline the policy implications of such a relationship and argue that '*the connection between inequality and health is one of the hottest topics in public health research today*'. In addition, available evidence shows that the income

distribution across US states is related to state-level measures of smoking (Kaplan *et al*, 1996), alcohol use (Marmot, 1997), abdominal weight gain (Kahn *et al*, 1998) and homicide by firearm (Kawachi *et al*, 1998).

There is a variety of psycho-social factors through which income inequality might influence individuals' health. For instance, relative deprivation might lead to feelings of inadequacy and envy, which may in turn induce individuals to engage in self-destructive behaviours. One implication of this hypothesis is that one's health is much more influenced by her/his position in the income distribution, than by the absolute value of her/his income. In a recent study, Marmot (2004) pointed out that health and longevity are intimately related to one's position in the social hierarchy. He suggests that it is not the absolute level of income and resources that are important for health, particularly in rich countries such as Germany, France or the U.K., but rather the relative position in the social status. Furthermore, as Sen (1992) persuasively argued, the important issue in examining inequality is the notion of *capabilities*. It is not the level of income that an individual commands which matters but what he or she is able to obtain. He argues that *relative income deprivation* can yield absolute deprivation in terms of *capabilities*. An important corollary of this view is that people whose relative position in the income distribution is relatively low would disproportionaly suffer from the effect of income inequality on health. This is assumption underlying the so-called weak *income inequality hypothesis* (IIH). However, relative income deprivation is not the only means by which income inequality might impact health. As argued by Mellor & Milyo (2002), income inequality may simply undermine social cohesion and hinder the formation of social capital, which may in turn influence health through the pathways of crime, public assistance, individual behavioural risks and socio-economic factors (Mellor & Milyo, 1999, Blakely *et al*, 2002, Kawachi *et al*, 1997, Kawachi & Kennedy, 1997). Yet, this view is compatible with the weak as well as the strong IIH which stipulates that income inequality is a public bad for all members in a society, not only for the least well-off.

A number of empirical studies have highlighted a rather strong and robust correlation between health measures and different income inequality indicators. Le Grand (1987), Waldmann (1992), Wennemo (1993), Wilkinson (1996) and van Doorslaer *et al* (1997) show such a correlation to be significant across countries. Likewise, Ben Shlomo *et al* (1996) find a similar correlation across wards in Britain just like Kaplan *et al* (1996), Kawachi *et al* (1997)

and Lynch *et al* (1998) who consider states and metropolitan areas in the US. In contrast, Humphries and van Doorslaer (2000) fail to provide any similar evidence for Canada. However, the above studies suffer from a number of methodological limitations critically reviewed by Wagstaff & van Doorslaer (2000) and Mellor & Milyo (2002) who also argued that this literature relies on the use of aggregate data, which suffers from two main limitations. First, correlations between statistical aggregates do not necessarily reflect causal relationships at the individual level. For instance, as argued by Rodgers (1979) and by Gravelle (1998), if health is a nonlinear function of income, then income inequality may be spuriously correlated with aggregate measures of health. Second, it is impossible with aggregate data to discriminate between the weak and the strong IIHs. Furthermore, in these econometric models, covariates other than income inequality indices are very seldom controlled for. Yet, a number of studies have shown that the estimated association between income inequality and health is sensitive to a number of covariates and, in particular, to the effects of individual income (Soobadeer & Le Clere, 1999, Fiscella & Franks, 2000, Deaton & Paxson, 2001), individual characteristics such as education, individual risk factors (Muller, 2002, Osler *et al*, 2002, Sturm & Gresenz, 2002, Shibuya *et al*, 2002) and regional determinants of individual health (Meara, 1999, Mellor & Milyo, 2002).

Mellor & Milyo (2002) attempt to overcome the above limitations. They use the 1995-1999 waves of the March Current Population Survey (CPS) to investigate the effect of income inequality on individual self-assessed health, after controlling for a number of individual characteristics and for regional fixed effects. Interestingly, they also account for nonlinearities in the effect of individual income on health. They find that there is a robust negative association between income inequality and self-assessed health. However, this effect disappears when a number of other covariates are controlled for. In particular, the inclusion of household income reduces the size and significance of the effect of income inequality on health and the association is further reduced when regional dummy variables are also included.

This paper, first replicates MM's analysis by estimating almost identical specifications using the European Community Household Panel (ECHP) for 14 European Union countries. A variety of measures of income inequality is used, which are derived by using different geographic units. The model tests whether inequality has a significant effect on individuals'

health and whether such an effect is stronger for poorer individuals. The data from the 14 countries are pooled together and each one of the countries is treated as a separate geographic unit. Within-country regions are controlled for. Furthermore, an objective measure of health is also investigated. Finally, while MM simply pool the 5 CPS waves available to them, this study exploits the longitudinal dimension of the data and estimates random effect models.

Whether based on individual or on aggregate data, all the empirical analysis of the IIH resort to income inequality indices that are measured at the level of some geographic units such as countries, states or regions. In this paper it is argued that this may cause misleading results. The reason is that since there is no within-region variation in aggregate inequality measures, the coefficients on these might simply reflect regional fixed effects, not the impact of inequality *per se*.[2] Moreover, given that income distributions are skewed to the left, income inequality measures are also correlated with the proportions of poor individuals in each country or region, hence reflecting the effect of poor socio-economic statuses, not the effect of income inequality *per se*. Thus, in this paper an alternative strategy is proposed based on the individual's relative income rank-order which circumvents the above limitations. Unlike the conventional inequality indices, this paper uses the relative rank-order measure. This measure varies across individuals since it depends on their respective rank-order in the income distribution of the country where they live, and it also varies across countries, since it depends on the extent of income inequality in each country. Overall, the results show that income inequality has a strong and robust deleterious effect on objective as well as on subjective measures of individuals' health.

The paper is organized as follows. In section 2, the data are described and the estimation strategy, discussed. Section 3 reports the results from alternative methods and specifications. Section 4 concludes the paper.

[2] For instance, using French data, Jusot (2003) shows that regional income inequality is positively correlated with regional mortality whereas Jusot (2004) also highlights a negative correlation between regional medical density and regional mortality.

2. Data and Empirical Set-up

The aim in this paper is to analyse the association between income inequality and health. The European Community Household Panel (ECHP) is used which is an eight-wave panel survey that has been conducted by Eurostat over the period 1994-2001. The sample is restricted to individuals aged 24 to 75. Descriptive statistics by country are reported in Table 1. One advantage of these data is that they offer the possibility to perform cross-country comparisons using completely comparable data and to exploit the underlying information in terms of national economic and institutional differences. These data are used in two ways. First, each country is considered in isolation and the 15 sets of outcomes are then compared. Second, the country-specific data sets are pooled together to obtain a representative sample of the population of the European Union. In the former approach, in order to apply MM methodology, one needs to define geographic units with specific income and, perhaps, health distributions. Most of the American studies on this issue rely on the distinction between States to capture regional effects. It is assumed that there are notable differences between States in terms of legislative, economic and health institutions. An underlying hypothesis is that States are reasonable proxies of individuals' reference groups. However, for European countries there is no reason why administratively delimited regions would also delimit individuals' reference groups. Furthermore there is a homogeneity between the regions of the same country since there is no legislative, political or institutional regional differences that might justify a region-based analysis.[3] Therefore, only the results from the country-based analysis are reliable.

The benchmark specification of this study is of the following form:

$$h_{ijt} = a\pi_{jt} + b\bar{y}_{jt} + \varepsilon_{ijt}, \qquad (1)$$

where h_{ijt} denotes some indicator of the health status at time t of individual i in country j, π_{jt}, an income inequality index of country j, as measured in year t and $\bar{y}_{jt}$, year t mean individual income in country j. a and b are parameters to be estimated and ε_{ijt} is an error

[3] See for instance, Smith (1999) for a discussion of the problem of reference group definition. Another practical limitation of the region-based approach is that for some small EU member countries, no information on regions is available (e.g. Denmark and the Netherlands) whereas in some larger countries, only few regions are recorded in the data (e.g. Belgium and Greece). Despite these difficulties, the regional approach is adopted for 3 countries (France, Spain and the UK). The results are qualitatively similar to those reported in the paper. Though not reported for space considerations, these region-based results are available from the authors upon request.

term. Two hypotheses regarding the structure of the error term are alternatively considered. With $\varepsilon_{ijt} = \varphi_t + \eta_{ijt}$ and $E(\pi_{jt}\varphi_t) = E(\bar{y}_{jt}\varphi_t) = 0$, equation (1) reduces to a time fixed effect model which can be estimated by pooling the successive waves of the panel and controlling for year dummies. With $\varepsilon_{ijt} = \delta_i + \nu_{ijt}$ and $E(\pi_{jt}\delta_i) \neq 0$ and/or $E(\bar{y}_{jt}\delta_i) \neq 0$, it is estimated as a random effect model. This, does not preclude the possibility to account for time fixed effects as well through sets of dummy variables.[4]

The test for the IIH relies on the significance of the a parameter which measures the impact of the country's income inequality on the health of its inhabitants. However, similarly to MM, the individual mean income is systematically controlled for. This is necessary as one also needs to account for the respective positions of country-specific income distributions. In specification (1), though the left-hand side is measured at the individual level, both variables on the right-hand side are aggregates that are measured at the country level. As such, it fundamentally differs from the conventional specifications that are usually estimated to assess the correlation between health and income inequality. That is:

$$\bar{h}_{jt} = a\pi_{jt} + b\bar{y}_{jt} + \varepsilon_{jt}, \qquad (2)$$

where $\bar{h}_{jt}$ denotes the health status of the average individual in country j at time t. For comparison purposes, specification (2) is also estimated and two alternative hypotheses regarding the error structure are considered. With $\varepsilon_{jt} = \varphi_t + \eta_{jt}$ and $E(\pi_{jt}\varphi_t) = E(\bar{y}_{jt}\varphi_t) = 0$, equation (2) is a time fixed effect model which can be estimated by pooling the successive waves of the panel and controlling for year dummies. With $\varepsilon_{jt} = \delta_j + \nu_{jt}$ and $E(\pi_{jt}\delta_j) \neq 0$ and/or $E(\bar{y}_{jt}\delta_j) \neq 0$, it is estimated as a random (country) effect model.[5]

Compared to (2), specification (1) has the advantage that it can be extended to include a variety of characteristics that have been shown to affect the sensitivity of the effect of income

[4] Since the time fixed effect and the individual random effect models yield qualitatively similar results, only the results from the latter model are reported. The results from the time fixed effect model are available upon request.

[5] See footnote 3.

inequality on individual health. Thus, the specification is extended by controlling for regional fixed effects, household income and a variety of individual demographic characteristics.[6] Household income is used as a proxy of the economic resources that are accessible to the individual.[7] However, the relationship between income and health is unlikely to be linear. Following MM, splines of household income are also included as regressors. Thus, within each country, five dummy variables are constructed indicating the quintile to which each individual's household income belongs, which are then multiplied by the household income variable. The individual characteristics included are age and its square, the two highest qualification dummies (lower secondary education or below being the omitted group), a gender dummy (females being the omitted group) and two marital status dummies (the single individuals being the omitted group).[8]

Similarly to the CPS, individuals in the ECHP are asked to self-assess their health by the following question:

"How is your health in general?"
(1: very good, 2: good, 3: fair, 4: bad, 5: very bad).

Two alternative strategies are adopted. First, like MM, a qualitative health variable (h_{ijt}) of value 1 for individuals reporting a good or very good health status and 0 otherwise is constructed. In this case, the corresponding aggregate variable ($\bar{h}_{jt}$) measures the proportion of country *j*'s inhabitants who report good or very good health statuses. However, this approach does not take into account national differences in the self-assessment of health. To be more specific, it is well known from the literature that countries with very comparable

[6] MM's specifications include Metropolitan State Area dummies.

[7] For cross-country comparability, both individual and household income have been deflated using the series of year-specific Purchase Power Parity indices included in the data by Eurostat. For household income, the equivalized income - income per consumption unit- is used.

[8] Highest qualification variables in the ECHP are available only when individuals enter the survey and are not updated. It is assumed that for individuals who were already in the labour market at the time they entered the survey their educational level has remained constant over their presence period in the panel. Those who were still attending school when they entered the survey have been excluded from the data. Their proportion has not exceeded 1% in any of the countries. One reason for this is that the sample includes individuals 24 years of age or older.

objective health distributions (say, France and the UK) have completely different self-assessed health distributions. To account for these differences the strategy adopted here is to give h_{ijt} value 0 for individuals reporting a health score below the mode of the national distribution and 1 for individuals reporting a score that is equal or higher than the mode. Because the results from both strategies turned out to be qualitatively similar, only the outcome from the latter one will be reported and discussed in the paper.[9]

Furthermore, individuals in the ECHP are also asked questions which allow us to construct an index based on objective descriptions of health. These questions are:

1. *"Do you have any chronic physical or mental health problem, illness or disability?"* ("yes" or "no")
2. *"Are you hampered in your daily activities by any physical or mental health problem, illness or disability?"*. ("yes, severely", "yes, to some extent" or "no")

These two questions are used to construct a variable which takes value 1 for individuals who declared not having any chronic physical or mental health problem, illness or disability or having chronic physical or mental health problems, illness or disability but not being hampered in their daily activities. Alternative specifications are also estimated in which this relatively objective measure of health status is the variable to be explained.

Among the left-hand side variables, income inequality is of the greatest importance. It is measured by a variety of indices, computed for each year separately. They are alternatively included in the estimated specifications.[10] However, two important remarks are in order. First, the association between individual health and income inequality might be non-linear. In particular, it might be the case that income inequality has deleterious effects on the health of

[9] The results of the alternative specification are available from the authors upon request.

[10] Namely, the ratio of the ninetieth to the tenth percentile, the Gini coefficient, the proportion of individuals below the median income, the Theil index, the coefficient of variation, the Mehran, the Piesch and the Kakwani indices. Since the obtained results are systematically qualitatively similar, only the results associated to the first four measures will be discussed. The remaining results are available from the authors upon request.

the least well-off and no effect (or a weaker effect) on the health of individuals on the right of the income distribution. To account for potential non-linearities, splines of income inequality are included which are obtained by multiplying the inequality measure with the dummy variables which identify the quintiles of the income distribution. Second, the use of the conventional measures of income inequality implies that inequality is measured by an aggregate level variable. This might cause problems in interpreting the findings. The reason is that since there is no within-country variation in these inequality measures, the estimated coefficients might simply reflect country fixed effects which in turn might have nothing to do with inequality. In addition, these measures are by construction correlated with the skewness (to the left) of income distributions and therefore with the national proportions of individuals earning low income. In this case, the apparent effect of income inequality might simply reflect the impact of relatively high proportions of individuals with low socio-economic status in the country, rather than the effect of income inequality *per se*.[11] To deal with these issues the following strategy is adopted.

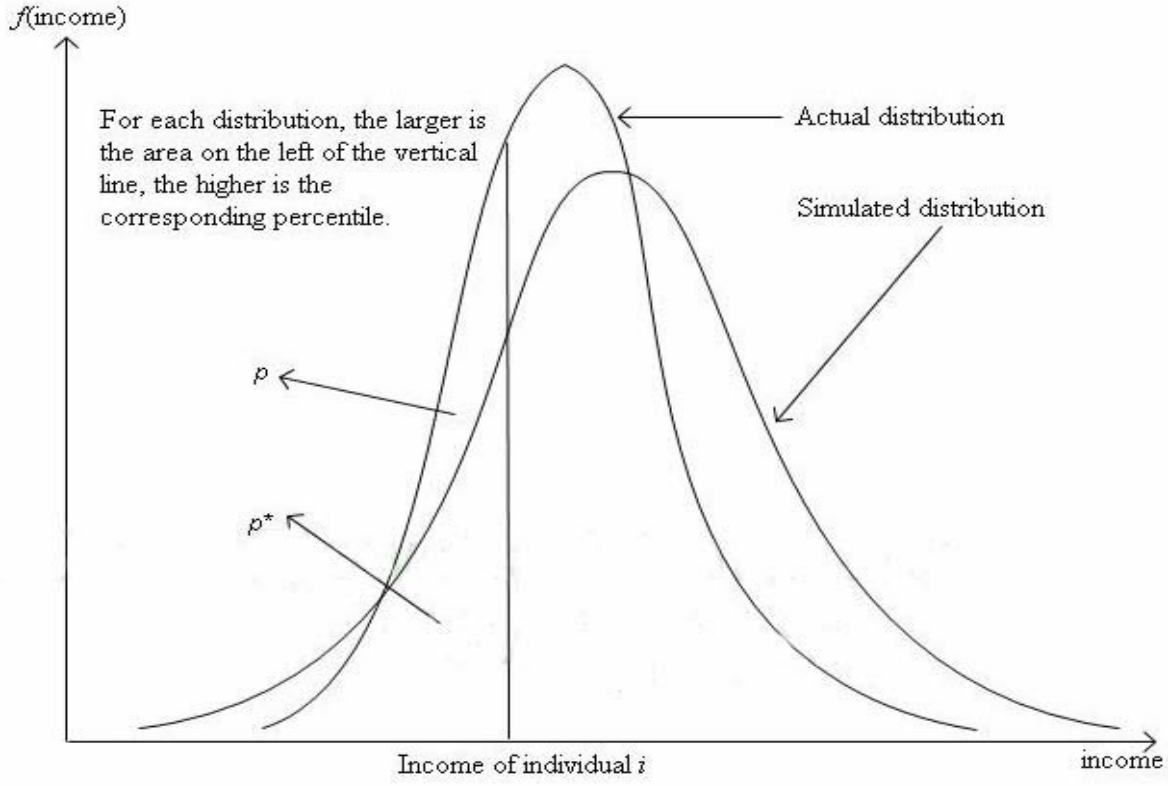
Consider individual *i* in country *j* and the rank-order (percentile), *p*, of this individual in the income distribution of country *j*. Consider also country *e*, where income is the least unequally distributed and let p^* be individual *i*'s rank-order in the income distribution of country *e*. Clearly, the higher is income inequality in country *j*, the larger the $(p - p^*)$ statistic will be. $(p - p^*)$ varies across countries depending on the extent of income inequality, but it also varies within any given country across individuals, depending on their respective rank-orders in the national income distributions. In addition, under the strong IIH, only the cross-country variation should matter whereas under the weak IIH, cross-individual variation should also matter.

Unfortunately, this strategy suffers from an important limitation. For all individuals in country *e*, where income is the least unequally distributed, $(p - p^*)$ is systematically zero. The same holds for individuals from other countries whose income is on one of the extreme sides of the income distribution of their own country (1^{st} and 100^{th} percentiles). The reference distribution must overcome these problems namely, to ensure that $(p - p^*)$ is a monotonically increasing

[11] Inclusion of national inequality measures in the right-hand side of the health equation makes it impossible to explicitly control for country fixed effects.

function of income inequality. Thus, instead of using the country where income is the least unequally distributed, a normal distribution of income is simulated which first, has the same mean with the overall income distribution of the 14 countries taken together and second, it has 1.5 times its standard deviation. Figure 1 illustrates the way the ($p - p^*$) statistic is computed for each individual, based on the simulated reference distribution and the distribution of income of her/his own country.

Fig. 1. Individuals' rank-orders in the actual and the simulated income distributions



3. Testing the Income Inequality Hypothesis

3.1. The Conventional Approaches

Table 2. reports estimates of specification (2) using alternative measures of income inequality. In this specification, the variables are all measured at the country level. The dependent variable is the proportion of people at time t in country j enjoying good health, where the latter is alternatively constructed from subjective and objective indicators. The health

variables are treated as continuous measures and the regressions are conventional random effect models with time fixed effects.[12]

A striking feature of the results is the systematically high significance of the coefficients associated with either the mean individual income or inequality measures. In line with the results reported in the literature, the effect of mean individual income is positive indicating that the higher it is in a given country, the higher will be the proportion of healthy individuals in that country. This implies that even if income inequality were the same across countries, individuals with higher income will on average tend to enjoy better health.

Furthermore, the results show that income inequality is negatively correlated with health independently of the measure of inequality used. This implies that if the mean individual income were the same in all countries, individuals would be healthier in countries where income inequality is lower. These aggregate-level estimates strongly suggest that income inequality has deleterious effects on health.[13] Importantly, there appear to be significant differences between the results obtained from the regressions on the subjective measure of health and from the ones based on the objective measure of health. First, the coefficients on mean income in the equations where the objective health is used are systematically higher in size and significance, compared to the respective coefficients obtained when the subjective health measures are used. This suggests that the level of income has a stronger effect on objective dimensions of health than on self-assessed health evaluations which may be affected by the psychological disposition of the respondents. Interestingly, the coefficients on income inequality on the objective health measures are systematically lower than on the subjective health ones.[14] This may imply that the effect of income inequality on evaluations of health is

[12] Note that the number of observations is 107 rather than 112 (8 waves times 14 countries) because for some countries the data do not cover the whole 1994-2001 period. Austria, Ireland and Luxembourg entered the survey in 1995 and Finland in 1996.

[13] One should note that reverse causality is also possible. Indeed, health might also have an effect on income inequality if bad health, for instance, results in lower earnings power or in a lower propensity to save and to accumulate wealth. If a large share of the population is in bad health, then, given the effect of health on socioeconomic status, this might worsen income inequality since the socioeconomic status of this part of the population will deteriorate. Hence, a high incidence of bad health status might worsen income inequality.

[14] The only exception occurs when income inequality is measured by the 90^{th} to the 10^{th} percentile ratio. This is probably due to the fact that this measure is defined by two points only from the income distribution and ignores any other distributional information.

higher than that on the actual health which may in turn reflect a degree of negative psychological well being or pessimism in more unequal societies.

As discussed earlier, in assessing the effects of income inequality on health one should consider the issue of the robustness of the above aggregate level data results. Thus in Table 3, Column 1, similar specifications are estimated using individual level data.[15] In line with the MM study, the dependent variable is a dummy variable which takes the value 1 if the respondent has good health and zero otherwise. The estimated models are random effect probits. The results show that the coefficients of the mean individual income and of the income inequality are both highly significant and exhibit a positive and a negative sign, respectively. This implies first, that if income inequality were the same across countries, individuals would be more likely to enjoy good health in counties with the higher average individual income and second, even if average income were the same across countries, individuals would be less likely to enjoy good health in countries which exhibit higher income inequality.

Yet, as mentioned in section 2, the above highlighted correlations might be simple statistical artefacts arising from the non-linear nature of the health - income relationship or from failure to account for individual characteristics and/or regional health determinants. The results reported in Columns (2), (3) and (4) of Table 3 aim at assessing the role of these factors. In the Columns (2), the estimated specifications are augmented using splines of household income. The inclusion of these splines in the estimated model results in a decrease in the size and significance of the respective coefficients for the mean individual income and income inequality though both remain highly significant exhibiting the expected signs. In addition, the splines of household income are systematically significant suggesting that, though the income-health relationship might be non-linear, the correlations between health and income inequality shown in Table 2. and columns (1) in Table 3 is not a spurious one. Moreover, the signs on the splines of household income show interesting patterns. The effect of mean income on health is negative for individuals belonging to the poorer two fifths of the income distribution but positive for the richer individuals. This implies that there is a poverty trap

[15] Table 3 reports only the results using the 90th to the 10th percentile ratio inequality measure. The results based on the remaining measures of inequality turned out to be qualitatively similar. They are available from the authors upon request.

phenomenon regarding health since an increase in the household income yields better health only for the top 60% of individuals in the income distribution. This, in turn, imply that, for the least well-off (the first 40% of the income distribution), either income is so low and/or health is so bad that a marginal household income increase does not suffice to yield any noticeable improvements in health.

Furthermore, Columns (3) and (4) in Table 3 show that only when individual characteristics and regional dummies are controlled for is there a sizeable decrease in the significance levels of the effects of the mean individual income and of income inequality on health. Nevertheless, both effects remain highly significant exhibiting the expected signs. In addition, the non-linear effects of household income remain highly significant and are consistent with the poverty trap - health phenomenon discussed above.

3.2. The Rank-Order Approach

The discussion in section 2 indicated that the significant correlation between health measures and the income inequality reported in Tables 2 and 3 might simply reflect country fixed effects. Yet, country fixed effects cannot be accounted for separately since income inequality indices (as well as the individual mean income) are evaluated at the country level. In order to disentangle the possible country fixed effects from the effect of income inequality *per se*, a measure of the individual's relative income rank-order is introduced as a substitute of the usual measures of income inequality. Unlike the conventional inequality indices, the rank-order measure varies across individuals since it depends on their respective rank-order in the income distribution of the country of residence, and it also varies across countries, since it depends on the extent of income inequality in each country.

The results of this analysis are reported in Table 4 and they are in line with those reported in Table 3. The positive effect of mean individual income on health is highly significant and positive. The health-income relationship is non-linear and the poverty trap – health phenomenon is again highlighted. Though the inclusion of individual characteristics and regional fixed effects reduces the significance level of mean individual income and income

inequality on health, the coefficients on these regressors remain significant. Finally, the rank-order measure of income inequality is negatively correlated with individual health.

The specification of the models reported in Columns (5) do not include country-fixed effects and exclude the mean individual income. In the earlier specifications country-fixed effects are used to capture any cross-country variation, including the differences in mean individual income, and the mean individual income is used to account for differences in the respective positions of national income distributions when assessing the effect of aggregate indices of income inequality. In the relative rank-order specification reported in column 5 the above issues are accounted for by the p^* measure which is drawn from a common reference distribution.

The results in Column (5) show that even after controlling for year, regional, country and individual characteristics effects, and for unobserved individual heterogeneity, through the random effects, the correlation between health and the relative rank-order income inequality measure remains significant. Since the rank-order measure varies across individuals and across countries, the high significance of its effect on health in a specification which includes country fixed effects might arise from two different effects: First, only the within-country variation in the rank-order measure matters and hence the health-inequality correlation simply reflects a relative income deprivation effect which implies that the effect of the rank-order variable on health to be positive. This implies that, the higher is the percentile associated with one's income, the healthier he or she would be. Second, the country fixed effects do not suffice to capture the effect of income inequality. In this case the health-inequality correlation implies that there are within-country (or between individuals) differences in the effect of income inequality on health. Of course, both the above effects might be at play. In this case, the negative sign on the rank-order variable reported in Column 5 suggests that the latter effect outweights the relative income deprivation effect.

In an attempt to disentangle the above effects, the rank-order variable ($p - p^*$) is replaced in by p and p^*, separately. The results are reported in Table 5 and correspond to the unrestricted versions of the specifications in Table 4. Since p^* is controlled for, the coefficient on the relative income variable, p, reflects the within-country relative income effect which would be

observed if the individuals who have the same income in each of the European countries were ranked the same in a common (European) normal income distribution. This would imply that , no differences between the national income distributions would be expected and hence there should be no differences in the extent of income inequality. Thus, this coefficient measures the pure relative income effect.

Furthermore, since *p* is controlled for, the coefficient on the simulated rank-order variable, *p**, measures the relative income effect that one would observe across individuals in the European countries if they had the same position in the income distribution of their respective countries. That is, if there were no within-country differences in the rank-order of citizens' income. In this case, the relative position of individuals could differ across countries only if national income distributions were differently skewed to the left and hence, if the extent of income inequality differed across countries. Thus, the coefficient on the simulated rank-order variable, *p**, reflects a pure inequality effect.

It can easily be seen from Table 5 that while the effects of the individual mean income and of the household income remain comparable to those reported in Table 4., *p* and *p** appear to exert specific effects on health. In particular, the effect of relative income as measured by *p* is systematically positive and highly significant even in the most extended specifications (columns (3), (4) and (5)). Even if there might exist a country where income is normally distributed and where all European citizens would occupy the same rank-order (equal *p** for all individuals), individuals are more likely to enjoy good health if their position in the income distribution of their country is high. This is evidence for the relative income deprivation hypothesis. Note also that even in the most extended specifications, the effects of the household income and of the mean individual income remain significant. This suggests that both absolute and relative income have specific effects on health.

In contrast, the effect of the simulated rank-order variable as measured by *p** seems to be sensitive to the estimated specification and to the health measure under consideration. Its significance level decreases significantly when individual characteristics are included in the specification. Furthermore, the decrease in the significance level of the effect of *p** is larger in the objective health specifications, though its effect is significant at the 10% level in the preferred specifications reported in Columns (5).

An issue of importance is whether or not income inequality affects health via the income deprivation effect only. If the income deprivation effect were the only effect, then the weak significance of p^* on health would be expected to *a priori* cause the relative rank-order variable, $(p - p^*)$ to exhibit a positive sign, not a negative one as it appears to be the case in. However , as Table 4 shows $(p - p^*)$ exhibits a negative a significant effect on health even in the most extended specifications. However, the specifications in Table 4. are restricted versions of those in Table 5. The combined evidence arising from these two Tables suggest that income inequality is harmful to health not only through relative deprivation, but also via other factors (social cohesion, crime, etc).

3.3. The Weak and the Strong Income Inequality Hypotheses

Tables 6., 7. and 8. report results from specifications that are similar to those already discussed, but where income inequality is introduced as splines of household income which are derived by multiplying the quintile dummy variables of household income by the inequality indicator under consideration. Under the weak version of the IIH, the effect of income inequality on health is significant for only individuals on the left of the income distribution. Under the strong hypothesis, this effect is expected to be significant along the whole distribution.

In Table 6., the ratio of the 90^{th} to the 10^{th} percentile is used as the income inequality indicator. The results of the effect of mean income and of the household income splines on health are similar to those obtained in the earlier specifications. Thus, household income is negatively (positively) correlated with health for the poorest 40% of the population (the richest 60% of the population). Interestingly, Table 6. shows that the coefficients of the income inequality indicator is systematically negative and highly significant. This is in favour of the strong version of the IIH; namely income inequality is harmful to individuals' health, regardless of their positions in the income distribution.

Calculation of the ratio of the 90^{th} to the 10^{th} percentile requires information from two points only from the income distribution. It is therefore important to assess the robustness of the

results reported in Table 6. by using an inequality indicator which uses information from the whole income distribution. Table 7 reports results based on the Gini index. They confirm the findings of Table 6., thus providing further evidence in favour of the strong version of the IIH. Table 8 uses the relative rank-order index. The results are compatible with those reported in Tables 6. and 7. Within each quintile of the household income distribution, the relative rank-order measure is negatively correlated with health and this correlation remains highly significant after the inclusion of country fixed effects (though at lower significance levels). This is further evidence in support of the strong IIH.

4. Concluding Remarks

Using data from 14 European countries, this paper analyses the Income Inequality Hypothesis. In line with Mellor and Milyo (2002), this study departs from an aggregate level analysis and shows a negative correlation between income inequality and health. It explores the sensitivity of this correlation in four dimensions, (*i*) it considers individual data, (*ii*) it controls for individual income, (*iii*) it accounts for possible non-linearities in the health-income relationship, (*iv*) it includes individual characteristics and regional health determinants. The results show that all these factors are important since they influence the significance level of the estimated correlation, a result in line with the findings of Mellor and Milyo (2002). However, in contrast to their findings, this study shows that the health-income inequality correlation remains systematically negative and highly significant which favours the income inequality hypothesis.

Furthermore, the study succeeds in discriminating between the strong and the weak versions of the Income Inequality Hypothesis, that is whether income inequality is deleterious to the health of all individuals or to the least well-off only. The results show that income inequality is systematically negatively and significantly correlated with individuals' health, regardless of their position in the income distribution. This is evidence in support of the strong version of the income inequality hypothesis.

The paper also investigates the hypothesis that the correlation between individual health and aggregate indices of income inequality may be a statistical artefact as it might be reflecting

country fixed effects only. A variable is constructed which measures the distance between individuals' actual position in the income distribution and their position in a theoretical normal distribution of household income. One advantage of this measure is that it positively varies with the extent of income inequality across countries and across individuals, depending on their relative position in the income distribution in their own country. It is shown that the correlation between health and income inequality is robust to country fixed effects. In addition, two further important results are derived. First, health is correlated not only with the absolute household income but also with the relative household income (percentile or rank-order of individuals in their national income distributions). Second, health is negatively correlated with the relative rank-order measure, hence suggesting that relative income deprivation is not the sole explanation of the robust correlation between income inequality and health.

Overall, in this paper a significant effort is devoted towards evaluating the robustness of the income inequality hypothesis. In particular, both subjective and relatively objective measures of health are used within and across-countries. However, there is still at least one important dimension which needs to be investigated namely the issue of causality. Though the literature provides a number of explanations of why income inequality should have an effect on health, empirical analyses should also test for the reverse causal path. Health inequalities are very likely to have a causal effect on economic inequalities as well. Indeed, differences in health status yield differences in earnings power and in wealth accumulation opportunities and thus, have an influence on income inequality.

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Table 1. Descriptive Statistics

	AU	BE	DK	FI	FR	DE	GR	IE	IT	LU	NL	PT	ES	UK
Household income	12538.85 (7164.27)	13777.30 (14903.91)	13503.82 (7098.97)	11347.51 (6751.81)	11627.90 (8467.24)	12487.26 (6934.43)	6984.09 (5519.50)	10541.48 (8241.30)	9175.16 (6130.60)	21123.97 (11804.59)	12406.08 (7873.33)	6407.48 (5198.82)	8295.87 (5991.15)	12973.92 (9319.85)
Age	45.52 (18.58)	45.90 (17.80)	45.41 (17.75)	43.89 (16.76)	45.33 (18.10)	44.00 (16.96)	47.35 (19.00)	44.56 (18.55)	44.80 (18.05)	44.57 (17.69)	45.21 (16.94)	47.00 (19.22)	45.55 (19.33)	45.00 (18.20)
Subjective health	0.77	0.75	0.81	0.87	0.83	0.87	0.77	0.82	0.82	0.87	0.85	0.75	0.79	0.80
Objective health	0.76	0.76	0.807	0.77	0.76	0.80	0.71	0.73	0.75	0.79	0.77	0.70	0.73	0.74
Male	0.518	0.53	0.51	0.505	0.52	0.518	0.522	0.504	0.511	0.511	0.528	0.522	0.518	0.538
Married	0.586	0.604	0.524	0.582	0.567	0.628	0.651	0.577	0.617	0.552	0.633	0.630	0.590	0.554
Divorced or separated	0.131	0.164	0.164	0.112	0.132	0.132	0.115	0.095	0.089	0.141	0.118	0.125	0.108	0.174
Single	0.279	0.229	0.307	0.304	0.297	0.238	0.232	0.326	0.292	0.306	0.247	0.243	0.30	0.271
Higher education	0.056	0.276	0.267	0.270	0.195	0.180	0.132	0.130	0.067	0.123	0.158	0.051	0.157	0.376
Upper secondary	0.584	0.299	0.415	0.393	0.243	0.536	0.26	0.332	0.324	0.318	0.295	0.105	0.178	0.130
Lower than upper secndry	0.346	0.349	0.303	0.333	0.48	0.268	0.590	0.50	0.564	0.503	0.518	0.832	0.663	0.47
P90 / P10	3.45	3.36	2.74	2.97	3.69	3.21	5.44	3.93	4.08	3.21	3.23	5.30	4.30	4.40
Top 50	0.692	0.696	0.661	0.675	0.698	0.677	0.739	0.722	0.706	0.683	0.690	0.748	0.719	0.720
Theil	0.143	0.192	0.108	0.127	0.159	0.123	0.219	0.20	0.166	0.129	0.148	0.240	0.189	0.184
Gini index	0.282	0.296	0.238	0.25	0.293	0.260	0.351	0.323	0.303	0.269	0.280	0.369	0.325	0.320
Relative rank-order	50.41 (28.87)	50.4 (28.85)	50.47 (28.85)	50.42 (28.88)	50.44 (28.84)	50.43 (28.83)	50.49 (28.86)	50.40 (28.81)	50.44 (28.86)	50.46 (28.86)	50.48 (28.86)	50.43 (28.86)	50.45 (28.85)	50.29 (28.76)
Sample size	31 000	57 888	37 736	47 776	81 848	78 872	77 408	32 192	98 608	34 264	74 296	86 960	88 232	74 824

Note : For each country, the waves of the panel have been pooled and the above descriptive statistics, inferred. Descriptive statistics by year are available from the authors upon request. The successive columns refer to Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, the Netherlands, Portugal, Spain and the United Kingdom, respectively.

Table 2. The relationship between aggregate measures of health and income inequality indices.

Explanatory Variables	Subjective Health	Objective Health
Model 1		
Mean individual income	0.3863 (35.27)	0.4717 (36.80)
P90/P10	-0.0761 (13.89)	-0.1018 (12.09)
Model 2		
Mean individual income	0.3977 (35.45)	0.5086 (36.37)
Top50	-2.514 (13.41)	-1.757 (12.12)
Model 3		
Mean individual income	0.3411 (34.67)	0.4918 (36.77)
Theil	-1.432 (11.14)	-0.428 (12.28)
Model 4		
Mean individual income	0.3659 (25.02)	0.5239 (26.48)
Gini	-2.012 (14.48)	-1.004 (12.33)
Dependent mean	0.71	0.69
Sample size	107	107

Notes: Random (country) effects models. Absolute values of t-statistics in parentheses.

Table 3. The relationship between health and the P90 / P10 ratio.

Explanatory variables	Subjective health				Objective health			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Mean individual income	0.5049	0.0002	0.0578	0.0003	0.1373	0.0005	0.0984	0.0001
	(16.18)	(9.73)	(5.90)	(4.06)	(14.97)	(12.03)	(7.08)	(1.34)
P90 / P10	-0.1959	-0.1934	-0.0364	-0.0331	-0.0285	-0.0459	-0.0080	-0.0791
	(17.81)	(12.10)	(4.84)	(4.73)	(16.95)	(6.54)	(3.88)	(3.08)
Household income								
First fifth		-0.1272	-0.1152	-0.1415		-0.1134	-0.137	-0.1402
		(17.76)	(12.17)	(8.66)		(6.92)	(7.78)	(6.65)
Second fifth		-0.0446	-0.0078	0.0360		-0.0506	-0.0110	-0.0348
		(13.71)	(10.22)	(3.01)		(14.21)	(10.43)	(2.92)
Third fifth		0.1108	0.0049	0.1427		0.1137	0.0486	0.1021
		(11.32)	(10.18)	(10.56)		(11.62)	(12.42)	(10.47)
Fourth fifth		0.1486	0.0574	0.1427		0.1500	0.0974	0.1410
		(18.99)	(12.88)	(8.2)		(19.18)	(6.11)	(8.20)
Fifth fifth		0.1179	0.0508	0.1154		0.1189	0.0762	0.1155
		(26.40)	(24.99)	(22.89)		(26.66)	(19.21)	(21.97)
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Individual characteristics	no	no	yes	yes	no	no	yes	yes
Regional dummies	no	no	no	yes	no	no	no	yes
Log likelihood	-51 710.516	-48 842.42	-48 631.96	-48 426.36	-429 771.52	-428 210.1	-390 803.56	-328 092.45

Notes: Random effect probit models estimated using the 1994-2001 waves of the ECHP (922 645 individuals). Absolute values of z-statistics in parentheses.

Table 4. The relationship between health and the relative rank-order measure.

Explanatory variables	Subjective health					Objective health				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Mean individual income	0.0013	0.0005	0.0009	0.0050	-	0.0009	0.0002	0.1221	0.7353	-
	(21.89)	(15.03)	(10.68)	(6.42)		(15.30)	(12.32)	(4.99)	(3.26)	
Relative rank-order	-1.244	-1.2150	-0.0381	-0.1229	-0.1382	-1.2195	-1.1330	-0.0992	-0.1155	-0.2140
	(65.11)	(54.51)	(12.30)	(3.62)	(6.51)	(62.71)	(28.13)	(26.01)	(3.39)	(4.38)
Household income										
First fifth		-0.1134	-0.1728	-0.0422	-0.1236		-0.1350	-0.0527	-0.0329	-0.3274
		(16.9)	(10.83)	(7.79)	(2.99)		(8.27)	(4.18)	(3.31)	(2.57)
Second fifth		0.0506	0.0189	-0.0019	0.0652		0.0382	0.0749	0.0514	0.0840
		(4.21)	(3.60)	(2.06)	(4.06)		(3.20)	(6.18)	(4.68)	(3.10)
Third fifth		0.1137	0.0752	0.0113	0.1174		0.1040	0.1132	0.1235	0.1402
		(11.62)	(7.73)	(6.43)	(6.73)		(10.68)	(11.46)	(7.04)	(3.79)
Fourth fifth		0.1500	0.1108	0.0500	0.0553		0.1436	0.1380	0.0763	0.1147
		(19.18)	(14.23)	(12.56)	(10.77)		(18.39)	(17.58)	(10.62)	(4.98)
Fifth fifth		0.1189	0.0982	0.0243	0.0540		0.1163	0.1149	0.1322	0.1751
		(26.66)	(22.22)	(12.47)	(15.28)		(26.10)	(25.46)	(14.83)	(6.55)
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Individual characteristics	no	no	yes	yes	yes	no	no	yes	yes	yes
Regional dummies	no	no	no	yes	yes	no	no	no	yes	yes
Country dummies	no	no	no	no	yes	no	no	no	no	yes
Log likelihood	-429 201.03	-428 210.10	-411 420.20	-404 200.81	-350 433.26	-429 362.65	-428 283.11	-408 035.60	-359 146.79	-271 357.21

Notes: Random effect probit models estimated using the 1994-2001 waves of the ECHP (922 645 individuals). Absolute values of z-statistics in parentheses.

Table 5. The relationship between health and relative income.

Explanatory variables	Subjective health					Objective health				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Mean individual income	0.2571	0.0902	0.30616	0.0708	-	0.0011	0.0006	0.2990	0.0636	-
	(12.90)	(9.32)	(8.28)	(1.94)		(18.19)	(7.09)	(13.36)	(7.75)	
Relative income	0.1718	0.5661	0.1843	0.6060	0.097	0.1770	0.0345	0.0749	0.0104	0.0337
	(16.34)	(11.03)	(12.03)	(4.55)	(6.99)	(26.04)	(14.93)	(6.18)	(3.45)	(3.83)
Simulated relative income	0.1316	0.2382	0.0617	0.0055	0.0236	0.3679	0.3990	0.0901	0.3658	0.2017
	(13.97)	(3.75)	(1.62)	(1.77)	(1.73)	(14.66)	(4.30)	(1.34)	(0.39)	(1.67)
Household income										
First fifth		-0.1350	-0.3344	-0.0261	-0.0641		-0.1146	-0.0555	-0.0435	-0.0092
		(8.27)	(4.18)	(1.57)	(1.24)		(6.98)	(3.35)	(1.63)	(1.15)
Second fifth		0.0382	0.1242	0.0871	0.1195		0.0504	0.0726	0.0777	0.0467
		(3.20)	(2.39)	(7.18)	(6.05)		(4.20)	(6.00)	(6.43)	(5.24)
Third fifth		0.1043	0.0092	0.1208	0.0486		0.1130	0.1107	0.1139	0.0160
		(10.68)	(10.24)	(11.22)	(2.42)		(11.60)	(11.22)	(11.55)	(2.25)
Fourth fifth		0.1436	0.0561	0.1437	0.0974		0.1497	0.1366	0.1389	0.0726
		(18.39)	(12.04)	(10.20)	(6.11)		(19.13)	(17.32)	(17.63)	(6.00)
Fifth fifth		0.1163	0.0872	0.1180	0.0762		0.1180	0.1140	0.1157	0.0871
		(26.10)	(15.82)	(10.12)	(9.21)		(26.60)	(25.32)	(22.67)	(7.18)
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Individual characteristics	no	no	yes	yes	yes	no	no	yes	yes	yes
Regional dummies	no	no	no	yes	yes	no	no	no	yes	yes
Country dummies	no	no	no	no	yes	no	no	no	no	yes
Log likelihood	-57 654.92	-48 283.11	-48 172.81	-48 072.82	-47 656.14	-49 448.18	-48 275.65	-39 797.65	-39 699.49	-39 540.46

Notes: Random effect probit models estimated using the 1994-2001 waves of the ECHP (922 645 individuals). Absolute values of z-statistics in parentheses.

Table 6. Non-linearity in the relationship between health and the P90 / P10 ratio.

Explanatory variables	Subjective health				Objective health			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Mean individual income	0.0949	0.0927	0.0340	0.0177	0.0661	0.0435	0.0340	0.0511
	(15.90)	(11.22)	(10.53)	(4.30)	(13.90)	(10.60)	(4.49)	(3.68)
P90 / P10								
First fifth	-0.1636	-0.0709	-0.1636	-0.1365	-0.8211	-0.5838	-0.6555	-0.4693
	(12.64)	(11.96)	(9.64)	(3.05)	(11.04)	(9.06)	(4.98)	(3.13)
Second fifth	-0.1205	-0.1007	-0.0896	-0.1570	-0.9580	-0.3128	-0.4840	-0.6490
	(15.06)	(12.47)	(10.20)	(2.02)	(11.20)	(8.46)	(3.27)	(3.42)
Third fifth	-0.0305	-0.0647	-0.0305	-0.0346	-0.9060	-0.7086	-0.1507	-0.4148
	(10.41)	(11.55)	(9.41)	(4.22)	(11.12)	(10.78)	(5.39)	(4.89)
Fourth fifth	-0.0642	-0.0383	-0.0640	-0.0189	-0.7518	-0.4131	-0.1693	-0.1260
	(10.85)	(10.93)	(7.85)	(6.12)	(10.93)	(7.45)	(5.44)	(3.27)
Fifth fifth	-0.0960	-0.0016	-0.0960	-0.2152	-0.4681	-0.9390	-0.4380	0.1543
	(11.43)	(10.04)	(6.43)	(5.63)	(10.59)	(7.15)	(4.25)	(4.37)
Household income								
First fifth		-0.1612	-0.0735	-0.1307		-0.1102	-0.0874	-0.1579
		(21.99)	(11.08)	(2.67)		(21.52)	(11.24)	(4.94)
Second fifth		-0.3242	-0.0625	-0.1812		-0.1210	-0.0960	-0.2753
		(12.40)	(10.92)	(7.60)		(8.46)	(4.26)	(3.95)
Third fifth		0.0925	0.0242	0.0361		0.0598	0.0335	0.1358
		(21.16)	(20.46)	(10.40)		(18.93)	(10.57)	(5.15)
Fourth fifth		0.0203	0.0302	0.1110		0.0374	0.0439	0.0775
		(21.81)	(20.76)	(11.64)		(17.77)	(10.98)	(2.91)
Fifth fifth		0.1372	0.0304	0.0251		0.0264	0.0287	0.0215
		(21.24)	(19.74)	(12.23)		(22.36)	(12.57)	(7.90)
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Individual characteristics	no	no	yes	yes	no	no	yes	yes
Regional dummies	no	no	no	yes	no	no	no	yes
Log likelihood	-48 653.66	-48 648.11	-48 553.66	-48 052.82	-48 651.41	-48 542.25	-48 354.01	-48 050.94

Notes: Random effect probit models estimated using the 1994-2001 waves of the ECHP (922 645 individuals). Absolute values of z-statistics in parentheses.

Table 7. Non-linearity in the relationship between health and the Gini index.

Explanatory variables	Subjective health				Objective health			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Mean individual income	0.3659	0.2969	0.2606	0.2305	0.23467	0.0009	0.0002	0.0001
	(15.02)	(14.06)	(3.58)	(3.14)	(13.19)	(10.68)	(6.87)	(1.34)
Gini index								
First fifth	-0.6618	-0.2247	-0.7460	-0.5311	-0.1319	-0.0101	-0.0174	-0.0292
	(16.65)	(12.34)	(6.50)	(6.81)	(17.50)	(11.30)	(7.38)	(3.91)
Second fifth	-0.5157	-0.1128	-0.8330	-0.6184	-0.5737	-0.0939	-0.0783	-0.0377
	(14.14)	(10.90)	(6.21)	(6.27)	(13.02)	(12.14)	(10.11)	(4.89)
Third fifth	-0.5220	-0.2505	-0.8750	-0.6100	-0.5756	-0.0174	-0.0901	-0.0583
	(13.82)	(11.92)	(6.06)	(5.89)	(12.74)	(10.23)	(5.19)	(3.42)
Fourth fifth	-0.5916	-0.2247	-0.8485	-0.5564	-0.7283	-0.0092	-0.1107	-0.1419
	(14.45)	(11.78)	(6.11)	(5.94)	(13.44)	(11.15)	(3.52)	(3.85)
Fifth fifth	-0.3153	0.1040	-0.1858	-0.5910	-0.0370	-0.0337	-0.1946	-0.0675
	(12.92)	(11.05)	(5.07)	(4.85)	(15.28)	(12.86)	(4.52)	(2.39)
Household income								
First fifth		-0.0121	-0.0253	-0.0061		-0.1728	-0.0331	-0.0556
		(10.11)	(8.23)	(4.06)		(10.83)	(2.02)	(3.35)
Second fifth		0.0642	0.1459	0.1315		0.0189	0.0820	0.0727
		(2.38)	(0.71)	(0.68)		(1.60)	(0.79)	(1.00)
Third fifth		0.1802	0.2180	0.1790		0.0753	0.1168	0.1107
		(21.32)	(11.23)	(3.08)		(7.73)	(11.85)	(1.22)
Fourth fifth		0.1817	0.2152	0.1830		0.1108	0.1410	0.1366
		(21.98)	(11.93)	(2.73)		(14.23)	(8.91)	(7.32)
Fifth fifth		0.0327	0.0296	0.0297		0.0985	0.1172	0.1141
		(22.86)	(10.67)	(5.68)		(21.22)	(13.01)	(5.32)
Year dummies	yes	yes	Yes	yes	yes	yes	yes	yes
Individual characteristics	no	no	Yes	yes	no	no	yes	yes
Regional dummies	no	no	No	yes	no	no	no	yes
Log likelihood	-429 296.13	-429 265.70	-428 210.10	-428 083.11	-428 275.65	-391 142.02	-390 644.94	-390 099.49

Notes: Random effect probit models estimated using the 1994-2001 waves of the ECHP (922 645 individuals). Absolute values of z-statistics in parentheses.

Table 8. Non-linearity in the relationship between health and the relative rank-order measure.

Explanatory variables	Subjective health					Objective health				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Mean individual income	0.6448	0.0160	0.0661	0.2410	-	0.0017	0.0553	0.6670	0.6995	-
	(13.68)	(7.25)	(5.90)	(3.30)		(29.16)	(12.77)	(5.88)	(4.07)	
Relative rank-order										
First fifth	-0.1205	-0.1150	-0.1157	-0.2801	-0. 3350	-0.0427	-0.0134	-0.0024	-0.0445	-0.1934
	(15.06)	(12.16)	(9.18)	(6.76)	(5.34)	(6.09)	(5.93)	(4.32)	(3.02)	(3.15)
Second fifth	-0.1408	-0.0061	-0.0066	-0.3720	-0.4691	-0.1277	-0.0054	0.0082	-0.9450	-0.2645
	(15.59)	(10.17)	(10.19)	(6.33)	(4.69)	(17.45)	(14.28)	(12.22)	(4.50)	(3.89)
Third fifth	-0.1637	-0.0068	-0.0064	-0.3932	-0.1276	-0.1937	-0.0042	-0.0010	-0.5348	-0.1830
	(16.22)	(10.26)	(9.24)	(6.05)	(3.21)	(25.19)	(12.18)	(5.34)	(3.28)	(4.22)
Fourth fifth	-0.2340	-0.0587	-0.0584	-0.3532	-0.0478	-0.2385	-0.0080	-0.0040	-0.6350	-0.2643
	(18.20)	(12.95)	(10.93)	(6.11)	(4.20)	(30.60)	(23.88)	(9.13)	(5.33)	(5.61)
Fifth fifth	-0.1729	-0.0512	-0.0512	-0.5130	-0.0932	-0.3309	-0.0118	-0.0044	-0.3100	-0.2731
	(16.49)	(15.03)	(12.02)	(5.05)	(4.31)	(42.60)	(23.99)	(10.86)	(2.17)	(3.74)
Household income										
First fifth		-0.1579	-0.1517	-0.0145	-0.0493		-0.0345	-0.1157	-0.0747	-0.1901
		(11.94)	(10.93)	(6.13)	(5.03)		(10.65)	(9.18)	(10.65)	(2.05)
Second fifth		0.2753	0.2104	0.1380	0.2183		0.0015	-0.0066	0.1315	0.0854
		(12.95)	(11.78)	(5.70)	(3.97)		(10.04)	(4.19)	(3.56)	(8.11)
Third fifth		0.1358	0.1231	0.1965	0.2718		0.0124	0.0064	0.1439	0.2834
		(12.15)	(8.30)	(4.15)	(5.11)		(9.47)	(10.24)	(4.09)	(5.55)
Fourth fifth		0.0775	0.0499	0.1973	0.2734		0.04878	0.0584	0.0738	0.1321
		(10.91)	(6.71)	(5.82)	(3.21)		(12.50)	(11.93)	(5.37)	(6.72)
Fifth fifth		0.0215	0.0226	0.0297	0.1197		0.0249	0.0512	0.1360	0.1994
		(21.90)	(12.00)	(7.68)	(6.39)		(12.53)	(9.02)	(4.93)	(7.71)
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Individual characteristics	no	no	yes	yes	yes	no	no	yes	yes	yes
Regional dummies	no	no	no	yes	yes	no	no	no	yes	yes
Country dummies	no	no	no	no	yes	no	no	no	no	yes
Log likelihood	-51 792.24	-51 672.80	-51 589.41	-51 439.42	-50 145.10	-58 256.63	-51 804.04	-51 766.88	-50 266.13	-49 173.20

Notes: Random effect probit models estimated using the 1994-2001 waves of the ECHP (922 645 individuals). Absolute values of z-statistics in parentheses.