# The Role of Circumstances in Explaining Health and Income Related Inequalities in European Countries

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**Abstract**

A recent paper by Milanovic (2015) showed that half of variability in income of World population is determined by country of birth and income distribution within that country. Since health and income are generally strictly related, because individuals who are better off financially tend to have better health and better health habits, in this paper, we propose to estimate how much variability in health is determined by circumstances. We use data from the Survey of Health, Ageing and Retirement (SHARE) and the English Longitudinal Survey on Ageing (ELSA), two comparable multidisciplinary surveys that provide micro-level data on health and financial resources among the elderly for a large number of European countries. We used OLS regression models to estimate elasticities of various health and income outcomes using as a benchmark Milanovic' s explanatory variables, extending then the analysis to important circumstances as early-life conditions. In addition, we use quantile regression models in order to capture the effect of circumstances accounting for the variation of effort across population. Our results show that the inclusion of additional covariates measuring early-life conditions strongly increases explained variability for income as well as for health, while quantile regression marks that countries with higher levels of effort have better health and higher income.

*Keywords*: Inequality of opportunity, health and income inequalities, early-life circumstances, social determinants of health, Europe

*JEL classification*: I10, I12, I18

# 1 Introduction

Inequality represents a widespread and persistent phenomenon which becomes even more unnecessary and unjust when is due to living conditions rather than genes or effort. For this reason, tackling it should be a high priority at all levels of governance[1].

Inequality also leads to a reflection on the social justice problem, which takes its roots in the equality of opportunity theory (Rawls 1958, Dworkin 1981, Roemer 1993, 2002, 2012, Sen 1992). As known, equality of opportunity has been traditionally defined as the absence of barriers to achieve position or status for which individual starting conditions such as race, gender, class or income should not determine this possibility (Marrero & Rodríguez 2012). This principle is strongly linked with the social justice assumption, which stresses the request of compensating people for a variety of circumstances, a concept wider than socio-economic background, that are arbitrary distributed above people responsibilities.

The development of egalitarian theories, begun with Rawls (1971), has involved scholars from different disciplines and it was characterized by the effort to replace the concept of equality of outcomes with equality of opportunities (Roemer & Trannoy 2013). Most incisive philosophical contributions to the discussion were mainly from Dworkin (1981), who argued that persons resources, including talents and wealth, have to be separated from persons preferences that are in part endogenously determined by owns environment.

This ethical principle has been translated into formal economic models and it is increasingly influential in the debate about the measurement of inequalities in different fields of social studies with the idea that the objects of the measurement of inequality has to be less the individual achievements and more the individual opportunities (Björklund et al. 2012).

Roemer (2002) brings this philosophical debate into economics elaborating a new algorithm in order to formalize Dworkin s proposal of equality of opportunities. In particular, Roemer s provides a distinction between *illegitimate* inequalities, attributed to external causes upon the individual responsibility, and *legitimate* inequalities coming from individual potentiality and effort.

This paper provides an empirical assessment in terms of evaluating the role of circum-

[1]On the other hand, assuming that individuals are not responsible for their living conditions but are responsible for their effort allows elaborating the *compensation principle*, which aims to maximize the welfare of the worst-off individuals with the intent to eliminate all differences, and the *natural reward principle* that is based on the idea that is all right when people who expend higher effort should do better(Fleurbaey 2008).

stances (e.g. illegitimate inequalities) as determinants of income and health status. We contribute into the field of contextual determinants of income and health, extending the analysis to early life circumstances and using quantile regression in order to account for the quantile distribution of effort (endogenous variable) on household income and health.

There are some reasons for investigating inequalities in European regions. The most important is that health inequities across the European regions are known to be high, and the great geographical diversity of regions creates opportunities and starting points which policy-makers have exploited differently (Marmot et al. 2012).

In order to accomplish the mentioned aim, data are drawn from the Survey of Health, Ageing and Retirement in Europe (SHARE) joint with that of English Longitudinal Study of Ageing (ELSA) selecting the interview waves 2006, 2008 and 2010. We use these rich datasets that contain detailed current and retrospective information on health, socio-economic status, social and family networks and several variables of interest such as childhood conditions of more than 42000 individuals aged 50 or more[2]. Thus, these datasets allow distinguishing between current circumstances and circumstances that occurred earlier in life[3]. We draw from previous findings of literature using SHARE data, which have widely shown associations between social conditions and non-communicable diseases (Pincus et al. 1998), quality of work and health (Siegrist et al. 2007), early retirement and health (Celidoni et al. 2013, 2015), business cycle at birth and childhood health (Angelini & Mierau 2012), aging and health perception (Angelini et al. 2013). Also estimates from ELSA have shown a strong wealth gradient in the likelihood of reporting poor health among those aged 50 and over, with median wealth for those reporting good health around three times and of those reporting fair or poor health which persists at all ages (Banks et al. 2003).

Our results indicate that a significant part of variability of our outcomes is explained by country-specific circumstances. In addition, the inclusion of early-life covariates and their deviations from country averages for distributional percentiles, sets an increase of the explained variance for all the outcomes investigated with a relevance in magnitude for income and self-reported health. Quantile regression estimates are consistent with

[2]The European countries covered in the present study are: Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, Sweden, Switzerland, Czech Republic, Poland, England and Spain.

[3]Researches on this field provide a theoretical framework that comprehend three models (Kuh et al. 2003, Kuh & Shlomo 2004): the life-course hypothesis, which emphasizes the accumulation of advantage and disadvantage across the entire life course; the latency hypothesis, which describe how exposures in early life affects later health; the third model which asserts that there is no effect of social circumstances from earlier life.

previous results and they confirm a heterogeneous effect across quantiles showing that countries with higher effort have also better health and higher income and that the deviation from country average of early-life circumstances have an increasing effect across the quantile distribution of outcomes.

The paper is organized as follows. The next section contains a theoretical and empirical overview. Section 3 introduced the research design and the empirical model. Section 4 presents the data and the descriptive analysis. Section 5 discusses results and Section 6 reports conclusion and possible implications.

## 2 Literature review

Part of the literature states that a society achieves equality of opportunities when, what individuals accomplish is determined wholly by their choices and personal effort, rather than by circumstances beyond their control (Björklund et al. 2012). On the other hand, a large literature has flourished in the fields of equality of opportunity in the last two decades looking at the role of circumstances in determining individual achievements and extending the focus to other social outcomes such as education (Jones et al. 2014), culture (Tabellini 2010) or health inequalities (Marrero & Rodríguez 2012, Delaney et al. 2011).

Recently, starting with the seminal contribution of Fleurbaey (2008), several papers have tried to link the theoretical framework developed in the equality of opportunity literature with the long lasting tradition in health economics on the measurement of social and income related inequalities in health (Rosa Dias 2009, Trannoy et al. 2010, Marrero & Rodríguez 2012).

Milanovic (2015) demonstrated that about half of variability in income of World population is mainly explainable by two macro-circumstances: the country of birth and the income distribution within that country, without considering the micro-economic channel of income variability, and leaving limited space for effort. At the same time, economic, social-relational, service and physical aspects of the residential area and neighborhood are shown to be important for income and health (Macintyre et al. 1993). Some studies have shown significant associations between economic deprivation in the residence place and child health (Roberts 1997, O'Campo et al. 1997) and between neighborhood conditions and perceived physical or mental health (Duncan et al. 1998, Lewis & Sloggett 1998).

However, even if is clear that health is worse in certain areas than in others (Stafford & McCarthy 2006), what is less clear, is whether differences can be simply explained by the cluster of individuals with similar risk profiles into the same area (a composition effect), or whether they are due to addition effects of area of residence over individual factors (contextual effect).

Since observational researches and policy evaluations studies show that the foundation of adult health are laid in early life, further development of the equality of opportunity theory mainly focus on the role of early life circumstances in explaining later income, education and health (Kruk 2013, Kuehnle 2014, Bilger & Carrieri 2013, Pizzi et al. 2014, Wadsworth 1996). Indeed, life course epidemiologys literature (Kuh et al. 2003, Kuh & Shlomo 2004) asserts that poor circumstances during childhood can lead to less development via a chain that may include a raise of poor physical health and a reduction of physical, cognitive and emotional functioning in adulthood.

According to Wadsworth (1996), poor socio-economic environment in early life increases risks to health through the interaction of adverse environmental influences with developmental processes. A deprived environment is associated with poor maternal diet, smoking, alcohol abuse, and raised risk of infection for the children as well as for the mother during the prenatal period, and also with poor growth of the child which have adverse effects on adult diabetes, vascular disease, obesity and cognitive function. Moreover, not only children ' s health is positively related to household income but this relationship becomes even more pronounced as children grow older (Deaton 2003, 2009).

Finally, several studies has demonstrated the long-term influence of childhood socio-economic circumstances on adult health. Individual life may be regarded as combining biological and social elements, which interact with each other and the individual effort takes place within a social context which structures chances so that advantages and disadvantages tend to cluster cross-sectionally and accumulate longitudinally. Moreover, advantage or disadvantage in one sphere of life is likely to be accompanied by similar advantage or disadvantage in other spheres and a person past social experience become written into the physiology and pathology of their body(Marmot 2005).

In short, the social enviroment is literally embodied and the body records the past, which predisposes to future advancements and social advantages as well as disadvantages.

## 3 Data

The present paper use data drawn from the Survey of Health, Ageing and Retirement in Europe (SHARE) joined with the English Longitudinal Study of Ageing (ELSA). These datasets collect multidisciplinary and cross national panels of micro-data on health, socio-economic status of households and which provide information about the individual life histories with detailed retrospective assessments regarding childhood characteristics among the elderly for a large number of European countries. Data are collected by face-to-face, computer aided personal interview (CAPI) supplemented by a self-completion paper and pencil questionnaire and they include more than 45,000 individuals, aged 50 or more, from 21 European countries. The geographic location is provided according to the Nomenclature of Territorial Units for Statistics (NUTS). The considered sample consists of 42,446 individuals born between 1920 and 1956 who participated to the interview wave in 2006, in 2008 and 2010 with the conditional on having information about current income, self-reported health, chronic diseases, BMI, age, gender, marital status, employment status and education level and others. Our datasets have the advantage that it cover fourteen European countries, which give a broader perspective on European inequalities than previous studies in this areas, and the potential drawback that it use long recall data. Table 1 provides some descriptive statistics. Respondents are prevalently females (55%) and 65 years old on average. About the 50% of them are married and retired. While dependent variables are taken into account at individual level, independent variables consist in the country mean. The household income per capita is given by the total amount of net household income. This measure is composed by the sum over all household members of annual net income from employment and self-employment after taxes, annual value of monthly net wage at the end of the main job in their career if they have already retired and annual value of monthly life insurance payment received. Concerning health, authors consider three different variables: self-reported health, chronic conditions and the body mass index (BMI). In SHARELIFE, survey participants are asked to report their perceived health, which is composed by a range of status going from excellent, very good to poor. The dependent variable is a dichotomy answer that takes into account only fair and poor health. The asset value of chronic condition is a dichotomous variable which identify whether the survey respondent report more than three chronic diseases. Lastly,

the measure of BMI is a measure of body fat based on height and weight that applies to adult men and women.

– Table 1 here –

Descriptive statistics are mapped in the following figures (Figure 1, Figure 2 and Figure 3). The graphical representation aims to clearly the geographical picture regarding inequalities among countries, and to outline the difference between central and peripherical regions (i.e. Greece, Spain, Poland and Italy).

– Figures 1-2 here –

It is interesting to note that a very similar pattern is shown comparing income and chronic diseases distribution. Where the map highlights a higher concentration of chronic diseases (darker color), it also point out a lower presence of income (lighter color), standing out a strong relation between wealth and health. Concerning the BMI figure (Figure 3), despite it shows a similar distribution of higher BMI and lower income, it makes an exception for the UK and Italy where the pattern is in the opposite sense (higher in the UK and lower in Italy). In short, these three maps show that there is worse health among those countries at the bottom of the income level than among those at the top. Regarding early life circumstances, we specify a dummy variable that identifi es individuals who report a financial hardship at age ten years old and an indicator of a very limited number of books available in the household when the individual was ten. Financial hardship captures problematic economic condition during the survey respondents childhood, while having few books in the household at the age of ten may be seen as a proxy of parental education (Brunello et al. 2012). Histograms in Figure 4 and Figure 5 show early life circumstances distribution among considered countries. As is shown in these graphs, their pattern follows a similar trend of the outcomes with an correlated presence of income and education pointing out an higher concentration of few books is present in Italy, Spain, Greece and Poland.

## 4 Empirical strategy

Formally, the level of income $y_{ij}$ of an individual $i$, in a country $j$, can be expressed as follows:

$$y_{ij} = f(\alpha_j^s, \gamma_{ij}^l, E_{ij}, u_{ij}), \tag{1}$$

where $\alpha_j^s$ (with $s = 1, ..., m$) indicate country-specific circumstances, $\gamma_{ij}^l$ (with $l = 1, ..., n$) individual-specific circumstances, which also depend on the country of birth/residence, $E_i$ is individual effort, and $u_i$ an idiosyncratic error term.

Recently, Milanovic (2015) elaborated a new empirical formulation, assuming that effort is independent by circumstances. In this setting the average income $y_{dj}$ of individuals belonging to the $d-th$ decile of income distribution in country $j$ is explained by two external circumstances: (i) the average level of income in country $j$ ($m_j$) and, (ii) the level of income inequality within that country expressed as the Gini coefficient ($G_j$). That is, when allocated to a country at birth, a person inherit conditions that cannot be modified just by effort. The equation proposed is as follows:

$$y_{dj} = \beta_0 + \beta_1 m_j + \beta_2 G_j + e_{dj}. \tag{2}$$

where $y_{dj}$ is the average annual household per-capita income of individuals living in country $j$ and belonging to the $d-th$ decile of income distribution within that country. $m_j$ represents the countrys GDP per-capita PPS[4]; $G_j$ refers to the level of income inequality within country $j$ measured by the Gini coefficient, and $e_{ij}$ is the usual error term.

In this equation both explanatory variables represent external circumstances over which individuals have absolutely no control, and are assumed as strictly exogenous to individuals' effort.

Since it is well known that income and health are strictly related, (Adams et al. 2003), we believe it would be interesting to investigate the effect of such circumstances also on individuals' health outcomes. Moreover, we improve the baseline empirical specification of Milanovic (2015) by including measures of early-life conditions, which represent more accurate measures of country-specific circumstances to which individuals are exposed during their life-course, than contemporaneous GDP per-capita PPS and Gini index. For this purpose we exploit the availability of retrospective information collected in both SHARE and ELSA about living conditions during childhood.

Our final specification can be expressed as follows:

[4]As in Milanovic (2015) we do not use the average level of income within the country to avoid the reflection bias introduced by Manski (1993).

$$y^l_{pj} = \delta^l_0 + \delta^l_1 m_j + \delta^l_2 G_j + \delta^l_3 few\_books_j + \delta^l_4 fin\_hard_j + \\ + \delta^l_5 (few\_books_{pj} - few\_books_j) + \delta^l_6 (fin\_hard_{pj} - fin\_hard_j) + \epsilon^l_{pj}. \tag{3}$$

$y^l_{pj}$ represents the average of outcome $l$ for individuals belonging to the $p-th$ percentile[5] of the income distribution of country $j$. The outcomes that we analyse are: the average annual household per-capita income, the body mass index[6] (BMI), a variable taking value 1 if the self-reported health status of individuals is ''poor" and 0 otherwise, and the presence of chronic conditions, defined as a variable taking value 1 if respondents have more than 3 chronic conditions and 0 otherwise. The first two explanatory variables are the same used by Milanovic (2015). In addition we use two measures of early-life characteristics to which individuals were exposed at the age of 10: the share of individuals in country $j$ living in households with less than 10 books (few_books) and the share of individuals in country $j$ having experienced financial hardship during childhood, which is generally associated also to poverty later in life (fin_hard). Moreover, we included two additional control variables who measure the difference between the share of individuals in country $j$ and income percentile $p$ with few_books (or fin_hard) and the share of individuals in country $j$ with few_books (or fin_hard). Summarising, these variables account for the average level of education of parents and, according to Brunello et al. (2015), also for parental care early in life, for parental income, and for differences in such variables across percentiles of the distribution of income. Early-life conditions will be included step-wise, after country-specific circumstances, to measure their contribution in explaining income and health variability. Finally, $\epsilon^l_{pj}$ is the usual error term.

In order to evaluate the validity of our estimates, as in Milanovic (2015), we show results for a third specification where country dummy variables are included in order to assess the effect of other unobserved determinants at the country level. The adjusted R-squared of these models should represent the highest level of variability that can be explained using country-level circumstances. This can be formally expressed as follows:

[5]We use percentiles rather than deciles, as in Milanovic (2015), to have an higher number of observations since our analysis is based on a dataset including a smaller number of countries, only 12 compared to the 118 examined by Milanovic (2015)

[6]The BMI is computed as weight in kilograms divided by the square of height expressed in meters ($kg/m^2$). In ELSA, BMI is based on weight and height of respondents collected by a nurse, BMI in SHARE is computed using self-reported information. Even if it has been observed that BMI is an imprecise measure of body fat, because it does not distinguish fat from lean mass (Burkhauser & Cawley 2008, Prentice & Jebb 2001), it is found to be highly correlated with other measures of adiposity, such as the percentage of body fat.

$$y_{pj}^{l} = \chi_0^l + \sum_{i=1}^{N_C-1} \chi_0^l D_C + psi_{pj}^l. \tag{4}$$

Where $N_C$ is the number of countries involved in the analysis and $D_C$ is a set of country-specific dummy variables.

One fundamental limitation of this strategy is that individuals may choose the place where they want to live also according to their effort. Thus, if we cannot convincingly control for this aspect we may get biased results of the effect of circumstances on individuals' income and health. Moreover, in the previous specification the role of effort was not included, but it may be interesting to analyse the effect of circumstances holding constant the level of individual effort.

In order to include the effect of effort in our analysis we will adopt a quantile regression (QR) approach. Quantile regression is able to model heterogeneous effects and allows researchers to account for unobserved heterogeneity. Formally we can define the QR model as follows:

$$\begin{aligned} y_{pj}^{l,\theta} = \delta_0^{l,\theta} + \delta_1^{l,\theta} m_j + \delta_2^{l,\theta} G_j + \delta_3^{l,\theta} few\_books_j + \delta_4^{l,\theta} fin\_hard_j + \\ + \delta_5^{l,\theta}(few\_books_{pj} - few\_books_j) + \delta_6^{l,\theta}(fin\_hard_{pj} - fin\_hard_j) + epsilon_{pj}^{l,\theta}. \end{aligned} \tag{5}$$

Where the model parameters are obtained by minimising the weighted sum of residuals[7]; $y_{pj}^{l,\theta}$ is the estimated outcome $y$ at the $\theta - th$ conditional quantile and $\theta$ is chosen in the interval (0, 1), and $\delta_k^{l,\theta}$ are parameters, which now also depend on $\theta$, associated with the already described effects of circumstances.

Here, we assume that the effect of circumstances varies according to some individual unobserved characteristic, i.e. effort. From equation (5) we obtain the strctural quantile effects (SQE), that are more appropriate than the usual marginal effects from OLS since the level of unobserved heterogeneity is held fixed, (Doksum 1974). Formally SQEs can be expressed as:

$$\frac{\delta y^l(\theta, x)}{\delta x} \quad or \quad y^l(\theta, x) - y^l(\theta, x')$$

SQEs represent a causal or structural effect of $X$ on outcome, holding the ability

[7]See, Koenker & Bassett (1978) and Koenker & Hallock (2001) for a discussion of quantile regression model.

or unobserved heterogeneity $U$ fixed at $U = \theta$. SQEs typically vary across quantiles, implying heterogeneous, non-constant effects.

The only requirement about outcome variables to perform quantile regression is that they must be continuous, but since our dependent variables are measured as averages over countries and income percentiles, we conveniently transformed also dichotomous variables in continuous ones.

# 5 Results

## 5.1 Main estimates

Tables 2-4 show the results of our empirical investigation of the effects of country-specific and early-life circumstances on net annual HH income, and other health outcomes. In particular, we introduce country- and early-life conditions in our estimates with a step-wise procedure in order to highlight the contribution of each group of variables in explaining outcomes' variability. Table 2 lists results when only country-specific circumstances are considered. It is relevant to notice how, by using this very parsimonious specification we are able to explain more than 20 percent of total income variability, according to both the R-squared (22%) and the adjusted R-squared (21%) (column 1). The contribution of country-specific circumstances is smaller in our sample, compared to what found by Milanovic (2015), who estimated that these two variables alone were able to explain about 50 percent of income variability using the World Income Distribution (WYD) database for 118 countries. The gap between the two estimates is due to the different variability in European and World income distributions, and as we will try to test later also on to the covariates included in the model.

Focusing on health, we can see how a significant part of variability of these outcomes is also explained by country-specific circumstances. The results of the analysis on BMI can be seen in column 2 of the same table. In this case country-specific circumstances explain 12% of total variability, which roughly corresponds to more than 50 percent of the explained income variability (i.e., 12%/22% = 54%). The same result is found for having more than 3 chronic conditions (column 3), whereas a significantly higher share of variability is explained by country-level circumstances when we focus on individuals with a poor self-rated health (column 4) where the adjusted R-squared is 19%, which is very

close to that of income.

As anticipated in the previous section one contribution of this paper is that to include in the original specification of Milanovic (2015) other types of circumstances relevant to estimating more precisely the contribution of circumstances. For this reason Table 3 shows estimates from the same models presented above, but where also early-life circumstances are included. As we can see, the inclusion of these additional covariates, measuring educational (few_books) and financial background (fin_hard) and their deviations from country averages for each income percentile, seems very relevant. In fact, the adjusted R-squared of income equation increases from 21 % to 38 % (column 1), meaning that the additional controls explain 17 % points more of income variability. The contribution is more limited when we focus on BMI and chronic conditions, where the adjusted R-squared increases from 12, to 20 and 23 % (columns 2 and 3), respectively, and is similar to that of income if we look at self-reported health, where the increase goes from 19 to 40 % (column 4).

In Table 3 we show results from the model estimated including only country-specific dummy variables. Looking at income (column 1) we can see how the specification presented in equation (3) accounts for almost all the variability explained by the model with country dummies, equation (4) (i.e. 38%/42% = 90%). This figure decreases significantly when we focus on BMI where the ratio between adjusted R-squared is 62 percent (i.e., 20%/32%=62%), but increases significantly when we look at chronic conditions (23%/25%=92%) and self-reported health (40%/42%=95%).

– Tables 2-4 here –

### 5.2 Estimates using quantile regression

We present here the results obtained from quantile regressions, that aim at accounting for the effect of effort, which is an unobservable variable in our modele. Tables 5-8 present estimates at the 10-th, 25-th, 50-th, 75-th and 90-th quantiles of the conditional distributions of outcome variables. OLS estimates are included as benchmark.

Table 5 focuses on income. As regards country-specific circumstances, we can see that GDP per-capita PPS does not show any evidence of heterogeneous effects across quantiles and the estimated coefficients are quite stable as also documented in Figure 3. If we look

at the Gini index, instead, we can see how this variable is not significant below the median of the conditional income distribution, which means that up to a certain level of effort the level of inequality in the country of residence does not play a role in explaining income variability, whereas its effect is negative above the median, at the 50-th and 75-th quantiles, and becomes non significant again at the 90-th quantile. However, focusing on Figure 3 we can see how at the highest quantiles of the distribution of effort the effect of income inequality becomes positive and significant. As shown by Galor & Zeira (1993), the relation between income growth and inequality is a negative in developed countries and positive in developing ones. Generally this contrasting result is explained by higher investments in human capital of the latter group of countries. This interpretation is also consistent with our quantile estimates where the effect of inequality is negative or non significant, but becomes positive at the highest quantiles of the distribution of effort.

It is also interesting to notice how the Pseudo R-squared calculated from quantile regression shows an increasing dynamic and passes from 22 percent at the bottom of the conditional income distribution to more than 30 percent around the highest quantiles. The magnitude of this indicator is lower than that estimated from standard OLS, that was 38 percent, but this difference may depend on the fact that the two values are obtained from different methods.

The two proxies for early-life circumstances do not show any evident dynamic across quantiles. Estimates are never significant for few_books, and are significant in the central quantiles when we look at fin_hard. Instead, when we focus on the effect of the variable measuring the deviation of the average of few books in each income percentile from the average in the country, we find a negative decreasing effect across quantiles. This means that for higher levels of effort in the country the penalty implied by belonging to income percentiles with higher shares of few books has stronger negative effects on income. From our estimates this effect ranges from -0.0214 % points (se = 0.004) to -0.0315 % points (se = 0.002). Instead, the effect of belonging to percentiles with higher levels of fin_hard has more homogeneous effects.

Looking at Tables 6-8 we can investigate the heterogeneous effects of circumstances on health outcomes. Focusing on BMI, whose quantile estimates are listed in Table 6, we can see how GDP per-capita PPS has a negative effect on BMI, which decreases in magnitude at the highest quantiles of the distribution of effort. The Gini index presents

an interesting dynamic with negative and significant effects at the highest quantiles of the distribution of effort, consistently with the interpretation made for income, where increasing levels of effort were supposed to be correlated to higher human capital and developing countries, which generally are those where BMI reaches lower levels. The estimated effect of a unitary variation in the Gini index ranges from -0.0185 points (se = 0.010) at the median to -0.0477 points (se = 0.012) at the 90-th quantile. Few_books and fin_hard present increasing effects across quantiles, but the former is never significant and the latter has a negative effect, that goes from -0.0477 points (se = 0.008) at the 10-th quantile to -0.0288 points (se = 0.006) at the 75-th quantile and becomes non significant at the 90-th quantile. The deviations from country averages of both few_books and fin_hard are positively correlated with BMI and significant in some quantiles of the distribution of effort, but do not show evident heterogeneous behaviors.

Table 7 lists estimates when the chosen outcome is having at least 3 chronic conditions. Now GDP per-capita PPS does not show evidence of heterogeneous effects, whereas the Gini index is characterised by a decreasing dynamic across quantiles. Its effect passes from a 0.0032 % points at the 10-th quantile to 0.0028 %points at the median and becomes non significant hereafter. Consistently with previous interpretations countries with higher levels of effort, and consequently human capital, have better health. Few_books is almost never significant, except at the 10-th and 75-th quantiles with coefficients of -0.008 (se = 0.000) and 0.0004 (se = 0.000), respectively. Instead, fin_hard is significant and positively correlated with chronic conditions and presents a stable dynamic across quantiles. Finally, belonging to a percentile with higher levels of few_books and fin_hard increases the probability of having more than 3 chronic conditions, and for both indicators has an increasing effect across the distribution of effort.

The effect of circumstances on the percentage of individuals declaring to have poor or very poor health status, shown in Table 8, is quite stable and negative for GDP per-capita PPS, whereas the positive effect of income inequality estimated from OLS, is found only at the 10-th quantile of the distribution of effort, and is non significant across quantiles. Interestingly, few_books has a negative incidence at the lowest quantiles, -0.0020 (se = 0.001) at the 10-th percentile, that becomes positive and significant above the median. This means that for countries with lower levels of effort few_books decreases the probability of having a poor self-reported health, whereas as we move towards higher levels of effort

and human capital the effect is opposite. Fin_hard has a positive effect, which is also found to be stable across quantiles. Lastly, being in a percentile of income with higher levels of few_books and fin_hard increases the probability of poor SRH, but the estimated coefficients are stable across quantiles.

– Tables 5-7 here –

– Figures 3-5 here –

## 6 Conclusions

The European continent includes countries with close to the best health and narrowest health gaps in the World (WHO, 2015). Evidence from the literature suggests that this inequality is related to a long and sustained period of social, economic and health development (more socially cohesive societies with developed welfare states) which was not fully shared from all countries. This has stimulated the wide interest in the study of determinants of inequalities, motivating a large body of studies in the causal effect of external circumstances on income or health as well as the difficulty in measuring this effect.

We choose to define our research design following previous literature in order to add some contribution in continuity with research done. The differentiation between effort and circumstances (Roemer 2002) allows us to connect theoretical models coming from different fields of study in one paradigm that define as social determinants the conditions in which people are born, grow, live and age and the wider set of forces and systems shaping the conditions of daily life (WHO).

Baseline OLS regression evidence supports the hypothesis that circumstances affect individual achievements and quantile regression results also reveal the sensitivity of these determinants to income and health even taken into consideration the effort distribution. In particular, our findings add new evidence to the debate on the inequality of opportunity and on the relationship between countrys circumstances, early-life conditions and later income and health status. Firstly, it is notable that, by only including in estimation country-specific circumstances, we are able to explain a significant part of the variability in our outcomes even if smaller than what found by Milanovic (2015). Secondly, we provide evidence that, extending Milanovic s function to circumstances in early-life, the

explained variance in income and health strongly increases highlighting the importance of early-life conditions as determinants of future achievements. Thirdly, since most of the difficulties arise from the possible endogenous relationship between cause and effect, we provide findings of quantile regression that, capturing effort distribution, better accounts the role of circumstances on income and health.

Some policy implications of these results arise. Provided evidence suggest that promoting health, as well as promoting growth, without reducing inequalities is not enough. Moreover, as shown in this paper, early life conditions and parental background still play an important role in the inheritance process of health and income inequalities as well as the persistency of high level of inequality according to the geographical provenience.

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Table 1: Descriptive Statistics

| **Variable** | **Modalities** | **Obs** | **%** | **Mean** | **Std Dev** |
|---|---|---|---|---|---|
| | | **Outcomes** | | | |
| Net annual HH income | | 42278 | | 27214.02 | 32441.57 |
| BMI | | 40389 | | 26.98 | 4.19 |
| Chronic conditions | 1 | 42405 | 0.32 | | |
| | 2 | | 0.2 | | |
| | $\geq 3$ | | 0.19 | | |
| Self-rated health | Very Good | 42411 | 0.19 | | |
| | Good | | 0.38 | | |
| | Fair | | 0.25 | | |
| | Poor | | 0.09 | | |
| | | **Country-specific circumstances** | | | |
| GDP per-capita PPS | | 42446 | | 26726.76 | 4677.58 |
| Gini index | | 42446 | | 39.37 | 5.08 |
| | | **Early-life circumstances** | | | |
| Number of books in the HH at the age of 10 | $< 10$ | 41169 | 41.10 | | |
| | $\geq 10$ | | 58.90 | | |
| Episodes of financial hardship during childhood | yes | 40265 | 30.07 | | |
| | no | | 69.93 | | |

Table 2: Effect of country-specific circumstances on income and health

| **Variables** | **Net annual HH income** | **BMI** | **Chronic conditions $\geq$ 3** | **Self-rated Health: Poor** |
|---|---|---|---|---|
| GDP per-capita PPS | 0.0915*** | -0.0717*** | -0.0044*** | -0.0125*** |
| | (0.005) | (0.005) | (0.000) | (0.001) |
| Gini index | -0.0100* | -0.0265*** | 0.0024*** | 0.0039*** |
| | (0.006) | (0.006) | (0.000) | (0.001) |
| Constant | 7.5621*** | 29.8261*** | 0.1216*** | 0.5334*** |
| | (0.271) | (0.265) | (0.020) | (0.038) |
| Observations | 1,195 | 1,196 | 1,196 | 1,196 |
| R-squared | 0.22 | 0.12 | 0.12 | 0.19 |
| Adj. R-squared | 0.21 | 0.12 | 0.12 | 0.19 |

*Note: Robust standard errors in parentheses. Significant levels as follows: *** p<0.01, ** p<0.05, * p<0.1.*

Table 3: Effect of country-specific and early-life circumstances on income and health

| **Variables** | **Net annual HH income** | **BMI** | **Chronic conditions ≥ 3** | **Self-rated Health: Poor** |
|---|---|---|---|---|
| GDP per-capita PPS | 0.0885*** | -0.0593*** | -0.0048*** | -0.0131*** |
| | (0.005) | (0.006) | (0.000) | (0.001) |
| Gini index | -0.0021 | -0.0275*** | 0.0018*** | 0.0018** |
| | (0.006) | (0.007) | (0.000) | (0.001) |
| few_books | -0.0035** | 0.0034* | 0.0002 | 0.0006** |
| | (0.002) | (0.002) | (0.000) | (0.000) |
| fin_hard | -0.0032 | -0.0317*** | 0.0019*** | 0.0046*** |
| | (0.003) | (0.004) | (0.000) | (0.000) |
| few_book_perc | -0.0250*** | 0.0143*** | 0.0014*** | 0.0039*** |
| | (0.002) | (0.002) | (0.000) | (0.000) |
| fin_hard_perc | -0.0154*** | 0.0048* | 0.0006*** | 0.0019*** |
| | (0.002) | (0.003) | (0.000) | (0.000) |
| Constant | 7.5825*** | 30.4233*** | 0.0889*** | 0.4577*** |
| | (0.251) | (0.256) | (0.020) | (0.035) |
| Observations | 1,195 | 1,196 | 1,196 | 1,196 |
| R-squared | 0.39 | 0.21 | 0.23 | 0.41 |
| Adj. R-squared | 0.38 | 0.20 | 0.23 | 0.40 |

*Note: Robust standard errors in parentheses. Significant levels as follows: *** p<0.01, ** p<0.05, * p<0.1.*

Table 4: Effect of country-specific and early-life circumstances on income and health

| **Variables** | **Net annual HH income** | **BMI** | **Chronic conditions ≥ 3** | **Self-rated Health: Poor** |
|---|---|---|---|---|
| Constant | 9.7163*** | 27.0804*** | 0.1001*** | 0.3492*** |
| | (0.071) | (0.130) | (0.010) | (0.016) |
| Observations | 1,195 | 1,196 | 1,196 | 1,196 |
| R-squared | 0.43 | 0.33 | 0.26 | 0.42 |
| Adj. R-squared | 0.42 | 0.32 | 0.25 | 0.42 |

*Note: Robust standard errors in parentheses. Significant levels as follows: *** p<0.01, ** p<0.05, * p<0.1.*

Table 5: Effect of country-specific and early-life circumstances on income. Quantile estimates

| **Variables** | **OLS** | $Q_{0.1}$ | $Q_{0.25}$ | $Q_{0.5}$ | $Q_{0.75}$ | $Q_{0.9}$ |
|---|---|---|---|---|---|---|
| GDP per-capita PPS | 0.0885*** | 0.0874*** | 0.0861*** | 0.0835*** | 0.0876*** | 0.0872*** |
| | (0.005) | (0.009) | (0.005) | (0.003) | (0.005) | (0.009) |
| Gini index | -0.0021 | -0.0015 | -0.0062 | -0.0058* | -0.0169** | -0.0047 |
| | (0.006) | (0.012) | (0.006) | (0.003) | (0.007) | (0.013) |
| few_books | -0.0035** | -0.0018 | -0.0013 | -0.0009 | -0.0006 | -0.0027 |
| | (0.002) | (0.004) | (0.002) | (0.001) | (0.002) | (0.002) |
| fin_hard | -0.0032 | -0.0058 | -0.0072** | -0.0066*** | -0.0042 | -0.0002 |
| | (0.003) | (0.008) | (0.004) | (0.002) | (0.003) | (0.003) |
| few_book_perc | -0.0250*** | -0.0214*** | -0.0225*** | -0.0238*** | -0.0291*** | -0.0315*** |
| | (0.002) | (0.004) | (0.002) | (0.001) | (0.001) | (0.002) |
| fin_hard_perc | -0.0154*** | -0.0210*** | -0.0149*** | -0.0135*** | -0.0118*** | -0.0121*** |
| | (0.002) | (0.004) | (0.002) | (0.002) | (0.002) | (0.003) |
| Constant | 7.5825*** | 6.9620*** | 7.5759*** | 7.9388*** | 8.4981*** | 8.2923*** |
| | (0.251) | (0.537) | (0.274) | (0.149) | (0.246) | (0.521) |
| Observations | 1,195 | 1,195 | 1,195 | 1,195 | 1,195 | 1,195 |
| Adj. R-squared | 0.38 | | | | | |
| Pseudo R-squared | | 0.22 | 0.29 | 0.33 | 0.32 | 0.3 |

*Note: Bootstraped standard errors in parentheses. Significant levels as follows: *** p<0.01, ** p<0.05, * p<0.1.*

Table 6: Effect of country-specific and early-life circumstances on BMI. Quantile estimates

| **Variables** | **OLS** | $Q_{0.1}$ | $Q_{0.25}$ | $Q_{0.5}$ | $Q_{0.75}$ | $Q_{0.9}$ |
|---|---|---|---|---|---|---|
| GDP per-capita PPS | -0.0593*** | -0.0607*** | -0.0672*** | -0.0650*** | -0.0601*** | -0.0570*** |
| | (0.006) | (0.010) | (0.009) | (0.008) | (0.009) | (0.010) |
| Gini index | -0.0275*** | 0.0081 | -0.0062 | -0.0185* | -0.0339*** | -0.0477*** |
| | (0.007) | (0.011) | (0.012) | (0.010) | (0.010) | (0.012) |
| few_books | 0.0034* | 0.0014 | -0.0007 | -0.0002 | 0.0066** | 0.0059 |
| | (0.002) | (0.003) | (0.002) | (0.003) | (0.003) | (0.005) |
| fin_hard | -0.0317*** | -0.0477*** | -0.0525*** | -0.0431*** | -0.0288*** | -0.0052 |
| | (0.004) | (0.008) | (0.005) | (0.005) | (0.006) | (0.007) |
| few_book_perc | 0.0143*** | 0.0167*** | 0.0205*** | 0.0173*** | 0.0116*** | 0.0066 |
| | (0.002) | (0.004) | (0.002) | (0.003) | (0.003) | (0.004) |
| fin_hard_perc | 0.0048* | 0.0090* | 0.0025 | 0.0053 | 0.0077** | 0.0056 |
| | (0.003) | (0.005) | (0.004) | (0.004) | (0.004) | (0.006) |
| Constant | 30.4233*** | 28.4526*** | 29.9469*** | 30.7214*** | 31.0984*** | 31.4523*** |
| | (0.256) | (0.461) | (0.441) | (0.358) | (0.334) | (0.386) |
| Observations | 1,196 | 1,196 | 1,196 | 1,196 | 1,196 | 1,196 |
| Adj. R-squared | 0.2 | | | | | |
| Pseudo R-squared | | 0.15 | 0.15 | 0.15 | 0.1 | 0.07 |

*Note: Bootstraped standard errors in parentheses. Significant levels as follows: *** p<0.01, ** p<0.05, * p<0.1.*

Table 7: Effect of country-specific and early-life circumstances on chronic conditions ($\geq 3$). Quantile estimates

| **Variables** | **OLS** | $Q_{0.1}$ | $Q_{0.25}$ | $Q_{0.5}$ | $Q_{0.75}$ | $Q_{0.9}$ |
|---|---|---|---|---|---|---|
| GDP per-capita PPS | -0.0048*** | -0.0038*** | -0.0041*** | -0.0043*** | -0.0053*** | -0.0058*** |
| | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) |
| Gini index | 0.0018*** | 0.0032*** | 0.0029*** | 0.0028*** | 0.0011 | -0.0013 |
| | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) |
| few_books | 0.0002 | -0.0008*** | -0.0000 | 0.0002 | 0.0004** | 0.0004** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| fin_hard | 0.0019*** | 0.0014*** | 0.0019*** | 0.0025*** | 0.0015*** | 0.0012** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) |
| few_book_perc | 0.0014*** | 0.0003 | 0.0009*** | 0.0017*** | 0.0021*** | 0.0022*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| fin_hard_perc | 0.0006*** | 0.0001 | 0.0004* | 0.0005** | 0.0009** | 0.0008* |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Constant | 0.0889*** | -0.0172 | -0.0143 | 0.0030 | 0.1729*** | 0.3424*** |
| | (0.020) | (0.018) | (0.019) | (0.023) | (0.037) | (0.037) |
| Observations | 1,196 | 1,196 | 1,196 | 1,196 | 1,196 | 1,196 |
| Adj. R-squared | 0.23 | | | | | |
| Pseudo R-squared | | 0.09 | 0.16 | 0.15 | 0.15 | 0.13 |

*Note: Bootstraped standard errors in parentheses. Significant levels as follows: *** p<0.01, ** p<0.05, * p<0.1.*

Table 8: Effect of country-specific and early-life circumstances on self-reported health (poor). Quantile estimates

| **Variables** | **OLS** | $Q_{0.1}$ | $Q_{0.25}$ | $Q_{0.5}$ | $Q_{0.75}$ | $Q_{0.9}$ |
|---|---|---|---|---|---|---|
| GDP per-capita PPS | -0.0131*** | -0.0136*** | -0.0128*** | -0.0123*** | -0.0135*** | -0.0130*** |
| | (0.001) | (0.002) | (0.001) | (0.001) | (0.001) | (0.001) |
| Gini index | 0.0018** | 0.0039*** | 0.0012 | 0.0014 | 0.0009 | 0.0001 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) |
| few_books | 0.0006** | -0.0020*** | 0.0004 | 0.0011*** | 0.0012*** | 0.0014*** |
| | (0.000) | (0.001) | (0.001) | (0.000) | (0.000) | (0.000) |
| fin_hard | 0.0046*** | 0.0051*** | 0.0039*** | 0.0038*** | 0.0045*** | 0.0045*** |
| | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| few_book_perc | 0.0039*** | 0.0036*** | 0.0044*** | 0.0043*** | 0.0041*** | 0.0033*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) |
| fin_hard_perc | 0.0019*** | 0.0020*** | 0.0022*** | 0.0014*** | 0.0017*** | 0.0020*** |
| | (0.000) | (0.001) | (0.000) | (0.000) | (0.001) | (0.001) |
| Constant | 0.4577*** | 0.3182*** | 0.4310*** | 0.4575*** | 0.5650*** | 0.6503*** |
| | (0.035) | (0.049) | (0.047) | (0.038) | (0.066) | (0.079) |
| Observations | 1,196 | 1,196 | 1,196 | 1,196 | 1,196 | 1,196 |
| Adj. R-squared | 0.41 | | | | | |
| Pseudo R-squared | | 0.16 | 0.2 | 0.26 | 0.27 | 0.3 |

*Note: Bootstraped standard errors in parentheses. Significant levels as follows: *** p<0.01, ** p<0.05, * p<0.1.*

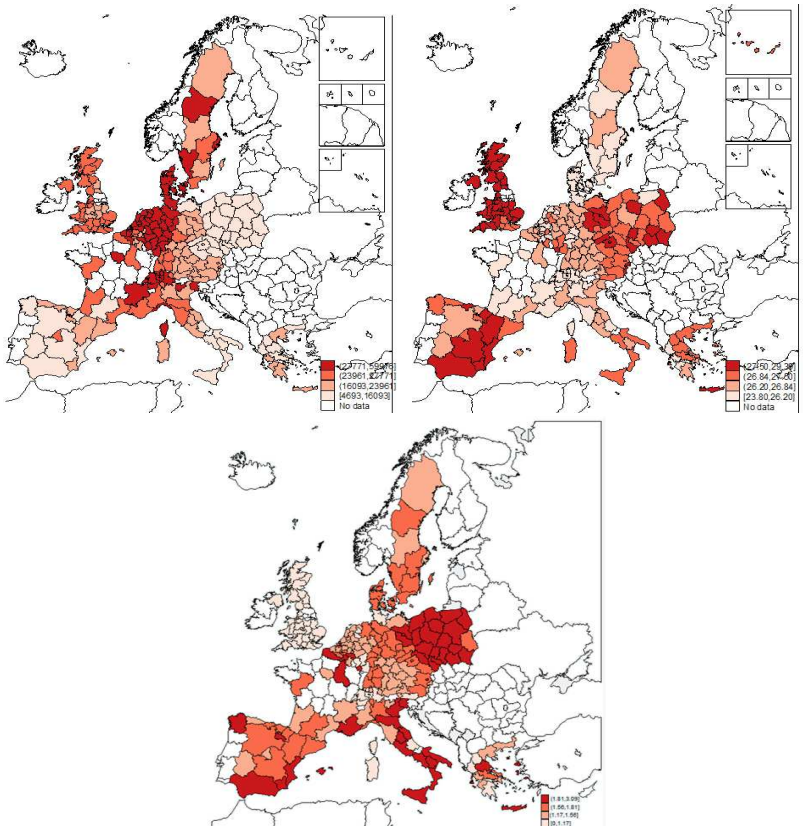

Figure 1: Geographic dispersion of net HH income (panel a), BMI (panel b) and chronic conditions $\geq 3$ (panel c), across European countries.

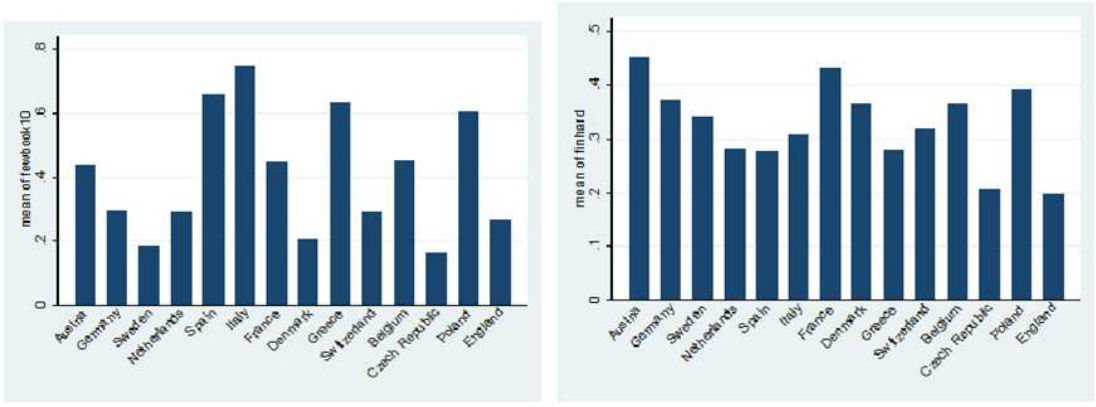


Figure 2: Share of few_books (panel a) and fin_hard (panel b), by country.

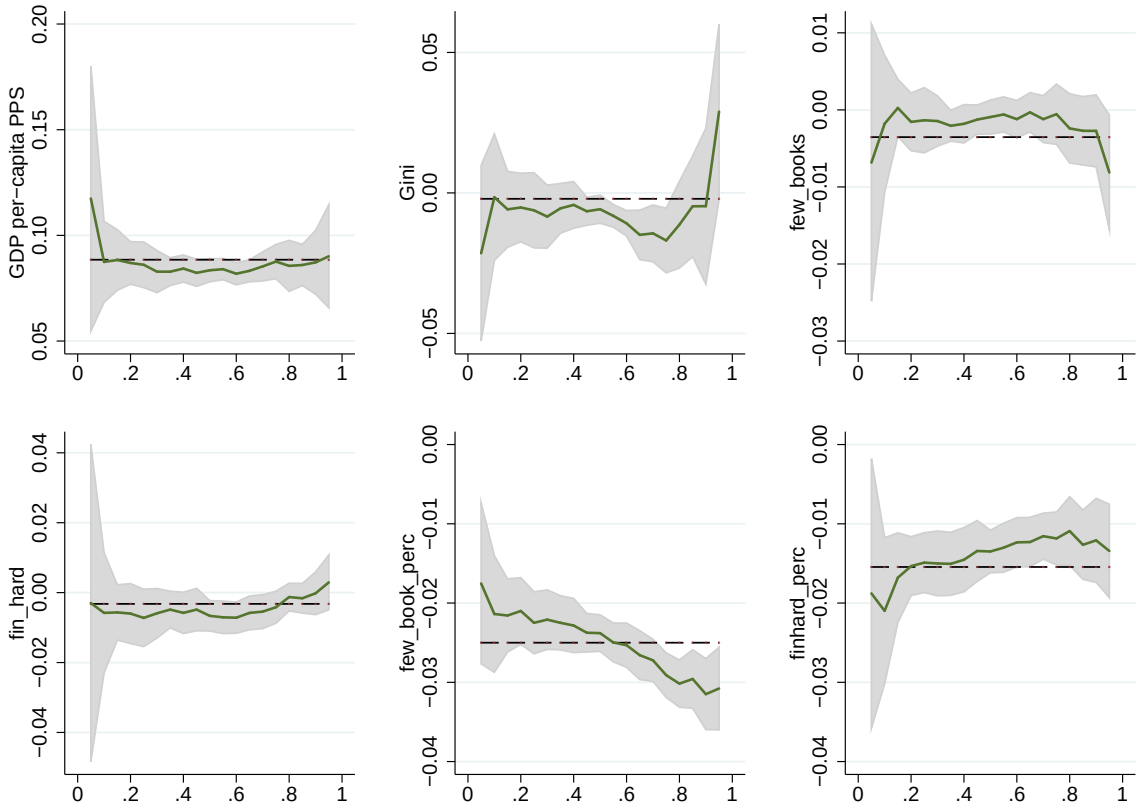


Figure 3: Quantile regression coefficients. Income.

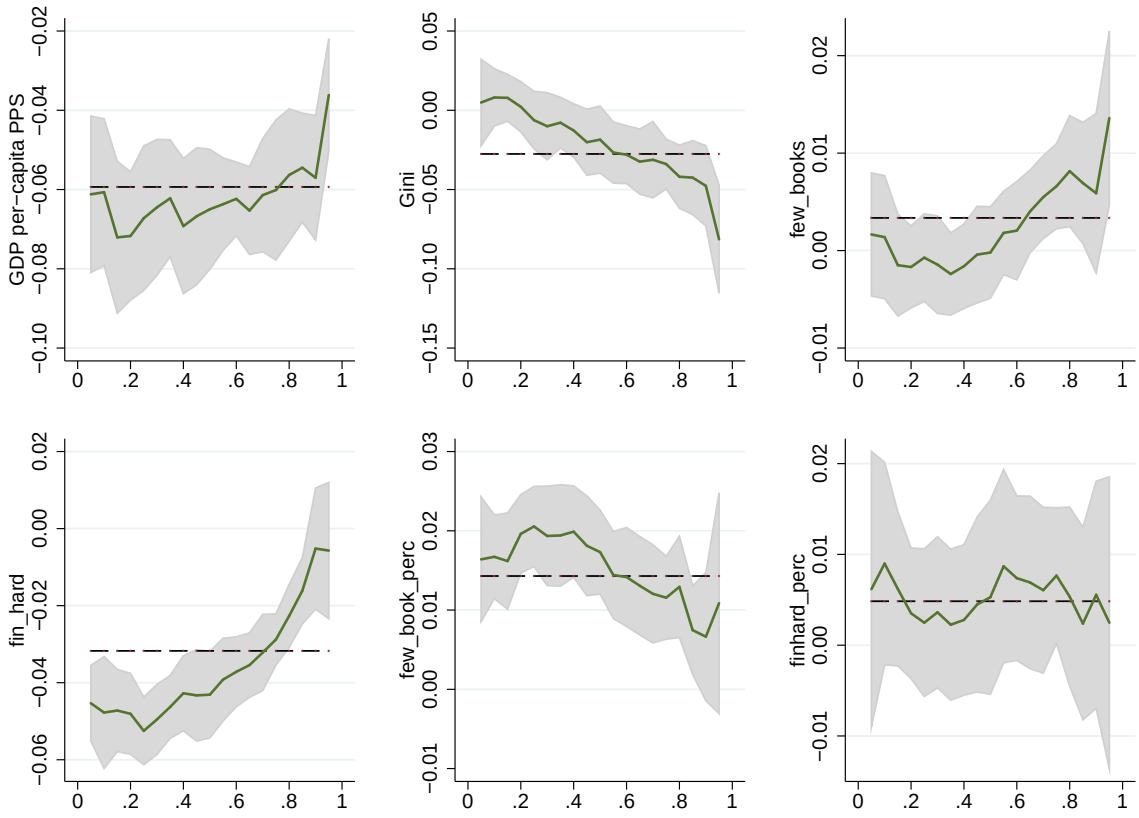


Figure 4: Quantile regression coefficients. BMI.

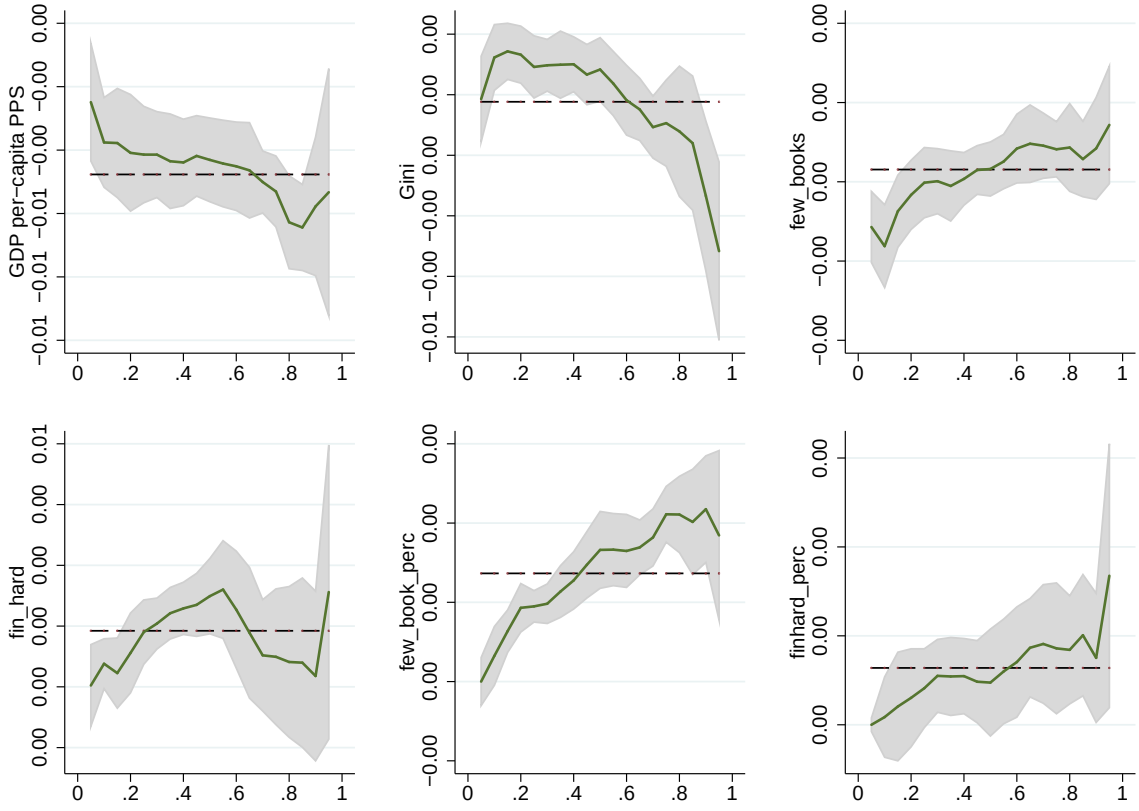


Figure 5: Quantile regression coefficients. Chronic conditions ($\geq 3$).

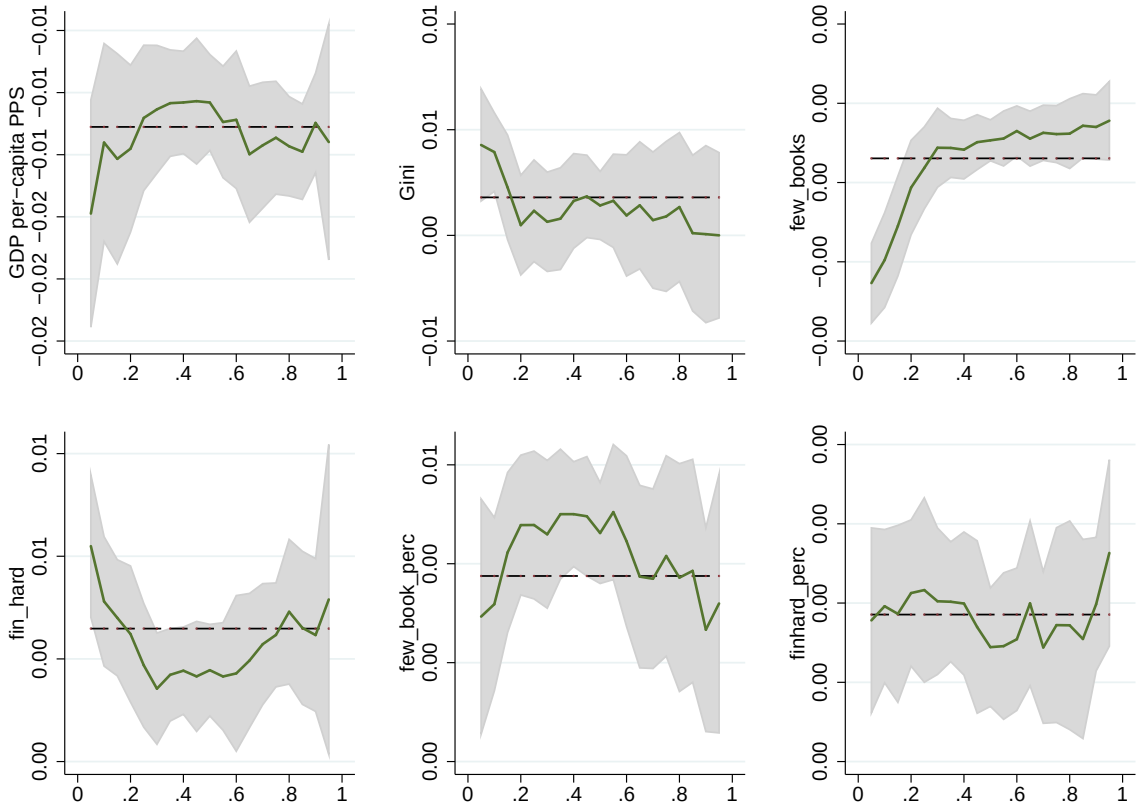


Figure 6: Quantile regression coefficients. Self-reported health: poor.

# APPENDIX A