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Inequality of Opportunities in Health in France: A First Pass.

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Abstract

This article analyses the role played by childhood circumstances, especially social and family background in explaining health status among older adults. We explore the hypothesis of an intergenerational transmission of health inequalities using the French part of SHARE. As the impact of both social background and parents' health on health status in adulthood represents circumstances independent of individual responsibility, this study allows us testing the existence in France of inequalities of opportunity in health related to family and social background. Empirically, our study relies on tests of stochastic dominance at first order and multivariate regressions, supplemented by a counterfactual analysis to evaluate the long-lasting impact of childhood conditions on inequality in health. Allocating the best circumstances in both parents' SES and parents' health reduces inequality in health by an impressive 57% using the Gini coefficient. The mother's social status has a direct effect on the health of her offspring. By contrast, the effect on descendant's health from their father's social status is indirect only, which goes through the descendant's social status as an adult. There is also a strong effect of the father vital status on health in adulthood, revealing a selection effect.

Keywords: Stochastic dominance – equality of opportunity – inequality in health – intergenerational transmission – older adults – Gini index

1. Introduction

It is a question that has hovered over the research in health economics for some time as testified for instance by the editorial of Dias and Jones (2007) in this journal or the report of the World Bank (2005): “what is the role and the extent of childhood conditions and more generally of initial conditions in current inequality in health among adulthood?” Of course, many studies show strong and long-lasting inequalities in health related to current socioeconomic status (van Doorslaer and Koolman 2004). Recent analyses support evidence that these social health inequalities can also be explained by living conditions in childhood, even *in utero* (Currie and Hyson 1999; Marmot and Wilkinson 1999; Smith 1999; Case *et al*. 2002; Currie and Stabile, 2003; Currie *et al*. 2007; Blane *et a*l. 2007). This article aims to get a step further in exploring the long-lasting effect of parents’ characteristics, especially their occupation and their longevity, on health status of descendants in adulthood.

The study of the correlation between social and health characteristics of one generation and the health status of the following generation is important from both a philosophical stance and a policy view point. As social background and parents' health both represent factors beyond the realm of individual responsibility (Dworkin 1981; Arneson 1989; Roemer 1998), they are socially or morally unacceptable sources of inequality. Consequently, they appear to be first-rate candidates for a policy aiming at reducing inequality in health (Fleurbaey and Schokkaert 2009). However at the same time, they are the most persistent sources of inequality and hence are difficult to cope with. Such an analysis of inequalities of opportunity in health matters for comparing the role of the transmission across generations in various spheres such as education, employment, housing or income distribution (Bourguignon *et al*. 2007; Lefranc *et al*. 2008; Ferreira and Gignoux 2008).

The first goal of this paper is to uncover an “association” between initial conditions and health status in adulthood for inequality of opportunity to be detected: a simple and purely descriptive correlation is relevant in that matter (Lefranc *et al*. 2006), provided that we stick to a relative view of effort as in Roemer (1998).

Of course, the study of the *channels* of transmission from one generation to another is also of interest, specifically in the perspective to design economic policies in that matter. Three potential ways of transmission across generations have been shown in the literature. The first way considers the direct influence of social background on health in adulthood following a latency period; it is the *latency model* (Barker 1996; Wadsworth 1999). During childhood, a specific risk takes place and it needs to be triggered in adulthood to be reactivated. The second way, called *pathway model*, relies on parents' socioeconomic status having an indirect influence on the health status in adulthood subsequent life trajectories and particularly through a transmission of socioeconomic status (SES) over different generations (Case *et al*. 2005)[1] and investment in children's human capital (Currie et al., 2009). The third way is the "*intergenerational transmission of health"* (Ahlburg 1998), which assumes parental health status to be correlated with the descendant's health status. Several illustrations may be provided of such a correlation. A common genetic stock within families comes to mind as a first example. Genetic inheritance has to be distinguished from hereditary dependence which comes from the same exposure to a risky living context such as accommodation or neighborhood conditions. The former example testifies to a causal link, while the latter only illustrates a positive correlation. Parents' health may also have an impact on descendant's health status through a transmission of preferences for health or lifestyles (Murray *et al*. 1985). Moreover, parents take into account their own health status in the choice of investment in their children's health capital (Jacobson 2000). Quantitative evidence from recent studies (Case et al. 2002; Llena-Nozal 2007) testifies to the importance of this third channel. Several

[1] Both models have been widely studied using British data and large epidemiological cohorts (e.g. Currie and Hyson 1999; Elstad 2005; Hertzman *et al*. 2001; Power and Hertzman 1997). In France, some studies using either the GAZEL cohort of employees from the national electricity and gas company (Hyde *et al*. 2006; Melchior *et al*. 2006a) or the Life History Survey (Melchior *et al*. 2006b), have shown an influence of the fathers' social status on both the health status and risk of death of their descendants.

studies have also shown evidence of inheritance in some specific diseases such as cancers and Alzheimer disease as well as in human longevity (Ahlburg 1998; Cournil and Kirkwood 2001). Nevertheless, the persistency of this effect on a descendant's health over the whole life-cycle, especially in older ages, has been seldom studied for lack of data.

The second aim of this research is to fill this gap and to investigate through which channel the intergenerational transmission of health inequalities finds its track. We use the French part of the 2004 Survey on Health, Ageing and Retirement in Europe (SHARE). Two different methodologies are used to explore inequality of opportunity in health. To measure the global impact of initial conditions on health, we use stochastic dominance analysis at first-order (Lefranc *et al*. 2006; 2008). Then, more conventional regression methods are used to identify partially the channels of transmission. Finally, we assess the contribution of inequality of opportunity in health to health inequalities using a counterfactual analysis.

The stochastic dominance analysis provides a first picture of inequalities of opportunities in health for descendants aged 49 and more. It shows the health gap associated with a lower social background or parents' longevity. The regression analysis provides additional information. In particular, channels of transmission are different for mothers and fathers. Mothers' social status has a direct effect on their offspring's health whereas the effect of fathers' social status is indirect only, going through the descendant's social status as an adult. Furthermore, there is a direct effect of the vital status of the father on health in adulthood and of the relative longevity of the mother. Hence the hypothesis of health intergenerational transmission is confirmed in general population. Finally, we show that allocating to all descendants both the best parents' socioeconomic status (SES) and health reduces the Gini coefficient of the probabilities of having a good or very self-assessed health status by 57%.

The following section describes the data. The third section defines the concept of inequalities of opportunity in health and describes the methods. Section 4 presents the results. A discussion and concluding remarks form the final section.

2. Data

This study relies on the French part of SHARE (Borsh-Süpan and Jürges 2005), which permits linking for the first time in France an individual's health status in adulthood with his social and family background on a representative sample of 2,666 adults aged 49 years and older[2]. In addition to their current situation (age, sex, education, socioeconomic status and their rank in their siblings), individuals are asked about their parents' final social status and whether their parents are still alive at the time of the survey and their age at death if need be.

Social background

In SHARE, social background is measured by the last job or occupation the father or the mother had. Occupations are described with the ISCO classification (International Standard Classification of Occupations). This classification distinguishes ten main groups of occupation with respect to the type of work performed (Elias, 1997). In our analysis, these ten groups have been gathered together in order to be comparable to the French classification of social classes[3].

Fathers' jobs are classified into six groups: (i) "senior managers and professionals", (ii) "technicians and associate professionals" and "armed forces", (iii) "office clerks" and "service workers and shop and market sales workers", (iv) "skilled agricultural and fishery workers", (v) "craftsmen and skilled workers" and "plant and machine operators and assemblers", and (vi) "elementary occupations and unskilled workers".

[2] The SHARE survey interviews households having at least one member aged 50 and over. Consequently, some respondents are less than 50. For representativity's sake, our analysis sample has been restricted to individuals aged 49 and over.

[3] The so-called Nomenclature des *Professions et Catégories Socioprofessionnelles* which is known to be relevant in the French context (Faucheux & Neydet, 1999; Desrosières, 2009).

Concerning mothers, a classification in six groups is also proposed. The first five groups are the same as the six groups of fathers' jobs, but groups (i) and (ii) have been grouped because of very low sample sizes. A sixth group for homemakers is added and represents almost one half of the respondents' mothers.

Current socioeconomic status of the descendant

Each respondent's current SES is considered at two levels: education and social status. We firstly consider education level, as measured by the highest diploma achieved. In this way, education is described in four categories: drop out, primary education, secondary and tertiary education. Then, current or last job as classified by ISCO is considered into seven groups. The first six groups are the same as fathers' job and a last group is included for homemakers.

Self-assessed health of the descendant

Health is a multidimensional parameter which is difficult to represent as a unique indicator. Self-assessed health (SAH) is the most collected variable in interview-based European surveys on health. Despite its subjectivity, this indicator has been found to be a rather good indicator of health, which predicts mortality (Idler and Benyamini, 1997) as well as health care utilisation (DeSalvo et al. 2005). SHARE contains two questions on SAH, the one, promoted by the RAND and the one recommended by the European WHO. They both rely on the same question: "*Would you say your health is …*" but vary in response choices, respectively: "*excellent, very good, good, acceptable, poor*" and "*very good, good, fair, poor, very poor*". Moreover, these two questions have been randomly positioned either before or after an extended questionnaire on health. Hereafter, we ignore the position effect[4] and consider the European wording (Fig 1).

Figure 1 about here

[4] The position of the question has been found to influence SAH: people report a better SAH when the question is asked after the extended questionnaire on health (Clark and Vicard 2007). Nevertheless, our results are the same whether we introduce in the model a variable indicating the position of the SAH question in the questionnaire or not.

The measure of parents' health: the relative longevity

Considering the age of the respondents, only 13% of fathers are still alive and 30% of mothers. Consequently, the vital status is the first information to measure parents' health. Then, the health status of deceased parents is evaluated using their age at death. We construct a health indicator comparing their actual longevity and their expected longevity at 20 years old. The indicator is defined as the difference between the actual age at death minus 20 and the life expectancy at 20 years old of their birth generation. We thus assume that health status is better if an individual has lived longer than other people of his generation, where all have survived at least long enough to have children. The construction of this indicator requires in addition to parents' age at death, their year of birth, which is unknown in the data. Its estimation is the conditional expectation on all available information: the descendant's year of birth and her position in her siblings. Daguet (2002) provides the actual mean age at both maternity and first maternity for any birth cohort in the 20th century. The mean age at maternity is used for any individual who is not the eldest of the family. When the respondent is the eldest among her siblings then we use the mean age at first maternity. As for fathers, the actual mean age at paternity is also available in Daguet (2002), and the mean age at first paternity is derived from the discrepancy of age at marriage between spouses and the mean age at first maternity[5].

The relative longevity of both parents is described in figure 2 and equals on average –0.67 years for mothers (median=2.18) and 5.5 years for fathers (median=7.78)[6]. These distributions

[5] This computation under-estimates the longevity of parents who gave birth old and it over-estimates the longevity of parents who gave birth young. We compare the estimated year of birth with the actual year of birth for parents who are still alive. The mean average difference between these two elements equals three years for the fathers and one year for the mothers. This positive bias is not correlated to parents' SES, except for mothers who were farmers. But as we see later, the results do not provide evidence of any specific effect of that social category.

[6] Considering that the relative longevity is only calculated for deceased parents and that many more mothers are alive, the mothers' mean relative longevity is expected to be negative. As for fathers, the positive mean longevity can be explained as follows. Firstly, SHARE has a selected sample where individuals have lived long enough to be interviewed in the survey at 50 or more. Secondly, there may be a positive correlation between health statuses of successive generations. Several studies (Lee *et al*., 2006) show that there is a strong probability to die

are spread as some generations experienced a very low life expectancy at 20 years old because of the world war and the Spanish influenza pandemic in 1918 and 1919.

Figure 2 about here

3. Concept and Methods

The non-parametric approach

This approach originates from Lefranc et al (2006) where success or failure is shaped by background, effort and luck. They show that in a world plagued with lack of information detecting inequality of opportunity relies on the comparison of cumulative distribution functions (CDF) of the outcome in which we are interested, conditioned on a set of variables representing background characteristics, so-called “circumstances” according to Roemer (1998). This general statement holds under the following ethical *proviso*. We stick to a relative view of effort, that is, effort is purged of any residual influence of circumstances. In other words, if effort to be in a better health, for instance doing physical exercise, is correlated to circumstances, this part of effort should be considered as a circumstance itself[7]. Only the part of effort independent from the childhood characteristics should be considered as a true effort variable.

In the present context, it means that we should be interested in the distribution of health statuses according to specific characteristics of childhood conditions. Being born in a particular family background does not belong to the sphere of individual responsibility and so, it is equivalent to get a lottery ticket, whose winnings will only be known later on. The CDF of health status of individuals born into a blue collar worker family 50 years earlier describes the distribution of opportunities in health of children of blue collar workers. If on the one

prematurely when the father had died prematurely. It could also be the case that males in poorer health are much less likely to marry and have children than males in good health. Thus, it is likely that the sample selects individuals whose father is robust. Another hypothesis is that biological (unknown) fathers are much younger than legal ones.

[7] For instance, Fogel and Costa (1997) show that low physiological capital provides poor incentives to invest in health (no smoking, no drinking, and exercising).

hand, this CDF is clearly different than the one of individuals born into a family of white collar workers and if on the other hand, this difference is such that a descendant has a higher chance of being in poor health when he is born to a blue collar worker, one can reasonably associate this result to a difference in opportunities in health related to social background. The previous example is a typical situation of stochastic dominance at first order.

Definition : Stochastic Dominance at First Order

Given any two health distributions A and B, with respective cumulative distribution functions $F_A(x)$ and $F_B(x)$, A dominates at first order B, written $A \geq_{SD1} B$, if and only if $F_A(x_j) \leq F_B(x_j)$, for any health status $x_j=\{x_1,x_2,\ldots, x_k\}$.

It means that health is better in distribution A than in distribution B for each category of health status: the share of the population in the worst category of health is lower (or no higher) for A than B as well as the share of the population in the lowest two categories, the lowest three categories, and so on. Graphically, the CDF of health statuses of individuals born to a blue collar worker is always above that of individuals born to a white collar worker at any point of comparison. In this context, the comparison of random distributions of health statuses conditional on social background leads any individual to prefer systematically being born to a white collar worker than born to a blue collar one, regardless of his risk-aversion. We are allowed to conclude that inequality of opportunity in health holds (see for a formal statement Lefranc et al. 2006 proposition 1).

The same approach can be proposed when comparing sub-groups of individuals according to any childhood characteristic such as health of parents. A direct interpretation of a "complete" intergenerational equality of opportunity in health would be that each circumstance does not endow any advantages not only on average but also on any percentile of the distribution of health statuses. If such a situation prevails, the distribution of health status is the result of misfortune, efforts, and other factors uncorrelated with observed circumstances.

Empirically, the inference procedure relies on tests of stochastic dominance at first order, such as unilateral *Kolmogorov-Smirnov* (KS) tests of equality of distribution, which are appropriate with discrete variables.

This approach remains relevant when circumstances are not fully observed. Indeed, Lefranc et al (2006, proposition 3 or 2009 proposition 5) show that equality of distributions conditional on social background is a necessary condition for equality of opportunity even if social background is not fully described. As a result, if the KS test shows significant differences between CDFs then we can say that equality of opportunity is violated if we had the opportunity to measure perfectly social background. This provides a rationale to perform the non parametric test separately on the CDF conditional on social background characteristics and on the CDF conditional on health of parents, which is helpful because of the relative small size of the sample.

The parametric approach

One of the difficulties of the dominance analysis is that it assumes the availability of large samples to perform inference tests. If we intersect every possible social background with other different criteria then the sample size reduces and the dominance statistical inference tests cannot be useful any longer. In particular, we cannot test the equality of opportunity hypothesis on sub-samples of people of same age and gender whereas we would like to control these two variables. Consequently, a multivariate regression analysis involving the descendant's SAH as the dependant variable supplements the dominance analysis. This second approach, using ordered Logit on the five categories of SAH, permits controlling age and gender. The analysis offers flexibility to test for a variety of hypotheses about the channels through which the intergenerational transmission goes.

We shall consider H_i*, the latent health underlying H_i, the SAH of the descendant *i*. Health in adulthood is assumed to be a function of individual's current characteristics, childhood circumstances and unobserved characteristics represented by u_i, which is assumed to be logistically distributed. We successively estimate three equations of health production functions, which gradually consider more determinants of health.

$$H_i^* = \alpha_0 + \alpha_1 Gender_i + \alpha_2 Age_i + \beta_1 SES_i^{Fath} + \beta_2 Alive_i^{Fath} + \beta_3 Long_i^{Fath} + \beta_4 SES_i^{Moth} + \beta_5 Alive_i^{Moth} + \beta_6 Long_i^{Moth} + u_i \tag{1a}$$

$$H_i^* = \{\text{the variables in (1a)}\} + \alpha_3 Educ_i + u_i \tag{1b}$$

$$H_i^* = \{\text{the variables in (1b)}\} + \alpha_4 SES_i + u_i \tag{1c}$$

In a first benchmark model, we estimate the impact of childhood circumstances, such as his parents' socio-economic status, SES_i^{Fath} and SES_i^{Moth} and their health status controlling respondent's age and gender[8]. The variables $Alive_i^{Fath}$ and $Alive_i^{Moth}$ are dummy variables indicating if the father (respectively the mother) is alive in 2004 and $Long_i^{Fath}$ and $Long_i^{Moth}$ are continuous variables representing the relative longevity of deceased parents. That initial specification gives evidence of the correlation between health status and childhood circumstances but this correlation cannot obviously be interpreted as causality. Moreover, it is interesting to understand through which transmission *channels* family background influences health in adulthood.

We thus consider two other specifications to test the pathway hypothesis. In model (1b), the respondent's education level, $Educ_i$ is introduced. Here, we test whether the influence of circumstances shown in model (1a) comes from a direct effect of this background on health or from an indirect effect going through education level. Finally, in a third model (1c) we add the respondent's social status, SES_i as an explanatory variable in order to single out the

[8] Relative longevity measure is estimated and the estimation procedure is a potential source of measurement error. As a robustness check, we estimate an alternative model, where this variable is replaced by a cruder variable, namely the parents' age at death. The odds ratio in this alternative model are very close to those in model (1a), except for age which is used to estimate parents' birth cohort.

direct effects of family and social background on SAH independently from the effect going through the respondent's socioeconomic status.

Measuring inequalities of opportunity in health

We are now interested in quantifying the inequality of opportunity in health and so, the actual impact of childhood circumstances has to be evaluated. This impact is made of two components: the direct effect as measured through model (1c) and the indirect impact going through the influence of circumstances on the characteristics of the descendant. In doing so, we shall ethically assume that the part of individual social characteristics, namely education and social status, correlated with social and family background are circumstances as well. This assumption is not the only ethical position that could be defended but it is a relevant assumption. It is clearly the assumption supported by Roemer (1998) about individual outcomes depending on circumstances and effort. He defined effort to be orthogonal to circumstances, meaning that everything correlated to circumstances is interpreted as a circumstance. How do we measure this global impact of circumstances on descendant's health?

If our regression model was linear, the answer would be quite easy. As the Frisch-Waugh theorem establishes in that case, the global impact is known to be captured by the coefficient of circumstances in the simple regression model like in the specification (1a). However, our model is not linear and the theorem does not strictly apply. In this context, the solution is the following. We regress the education level and the social status within two separated equations against the vector of circumstances. We then introduce the estimated residuals of these two equations into the third equation explaining health in adulthood along with the vector of circumstances.

The model is written as follows.

$$Educ_i^* = \alpha_0^a + \alpha_1^a Gender_i + \alpha_2^a Age_i + \beta_1^a SES_i^{Fath} + \beta_2^a Alive_i^{Fath} + \beta_3^a Long_i^{Fath} + \beta_4^a SES_i^{Moth} + \beta_5^a Alive_i^{Moth} + \beta_6^a Long_i^{Moth} + u_i^a \quad (2.a)$$

$$SES_i^* = \alpha_0^b + \alpha_1^b Gender_i + \alpha_2^b Age_i + \beta_1^b SES_i^{Fath} + \beta_2^b Alive_i^{Fath} + \beta_3^b Long_i^{Fath} + \beta_4^b SES_i^{Moth} + \beta_5^b Alive_i^{Moth} + \beta_6^b Long_i^{Moth} + \alpha_3^b \hat{u}_i^a + u_i^b \quad (2.b)$$

$$H_i^* = \alpha_0^c + \alpha_1^c Gender_i + \alpha_2^c Age_i + \beta_1^c SES_i^{Fath} + \beta_2^c Alive_i^{Fath} + \beta_3^c Long_i^{Fath} + \beta_4^c SES_i^{Moth} + \beta_5^c Alive_i^{Moth} + \beta_6^c Long_i^{Moth} + \alpha_3^c \hat{u}_i^a + \alpha_4^c \hat{u}_i^b + u_i^c \quad (2.c)$$

Equations (2.a) and (2.b) are modeled using binary Probit models[9]. The non linear specification does not allow directly estimating the residuals $\hat{u}_i^a$ and $\hat{u}_i^b$. We compute generalised residuals, which correspond to the conditional expected value of the residuals given the outcomes, $E(u_i^a / Educ_i^{High})$ and $E(u_i^b / SES_i^{High})$ (Gourieroux et al., 1987).

Equation (2.c) is modeled with an ordered Logit model. The coefficients associated to circumstances variables represent the sum of direct and indirect effects of circumstances on health. The generalised residual term $\hat{u}_i^a$ and $\hat{u}_i^b$ do not belong to the vector of circumstances as they are orthogonal to circumstances in this third equation. They represent individual effort, luck and unobserved circumstances permitting the individual to reach a high education level (resp. to get a high social status) considering childhood observed circumstances.

We argue that the impact of circumstances on the distribution of health in adulthood can be meaningfully assessed comparing the distribution of the predicted probability of having a good or very good SAH with a reference distribution. The reference distribution we use is the counterfactual distribution of the predicted probability of having a good or very good self assessed health status for the best circumstances for the individuals. The literature on health inequalities recommends reducing inequalities by an improvement of the health status of the most disadvantaged people and could not ethically suggest a deterioration of the health status

[9] An ordered Probit model estimating (2.a) would reject the test of parallel lines, while estimating (2.b), it would rely on an arbitrary ranking of social statuses.

of the most advantaged people. Our main objective is to compare the level of inequalities of both distributions and so, we use the most widespread statistical tool used to measure the inequality in probability to be at least in good health: the Gini index. We complete the analysis by resorting to an index proposed by Erreygers (2009) close to the Gini index but that does not suffer from some of its shortcomings. In particular the ranking according to health status is the same as the one according to ill-health status, a property which is not always satisfied by the Gini index.

4. Results

Results of the non-parametric approach

In the first approach, we compare distributions of health status, as measured by the 5-point health status variable, according to family and social background using stochastic dominance.

Dominance according to parents' relative longevity

In order to rely on comprehensive numbers of observations, parental health is considered as a 3-category variable which distinguishes (i) parents alive in the survey (ii) parents having had a high relative longevity (i.e. a relative longevity higher than the median of the relative longevity distribution), and (iii) prematurely dead parents (i.e. those having had a relative longevity lower than the median).

Figure 3 shows inequalities of opportunities in health according to both parents' health. The distribution of health of individuals whose parents are still alive dominates the distribution of health of individuals whose parents are deceased and differences are significant. On the contrary, no significant dominance is observed between distributions of health of individuals whose parents had a weak longevity and those of individuals whose parents had a high longevity. This first result does not allow us concluding that there are inequalities of opportunities in health related to parental health because the respondent's age, which is not considered, could explain those differences: younger respondents are more likely to be in better health and to have parents who are still alive.

Figure 3 about here

If we restrict the analysis to the age category 60-69 years old, which contains both alive and deceased parents, the comparison of distributions of health related to parents' health shows CDFs favouring individuals whose parents are alive, and then individuals whose parents experienced a high longevity but the corresponding KS tests do not confirm significant differences between distributions[10].

Dominance according to social background

Figure 4-A represents the CDFs of descendants' health conditional on their father's social status. Respondents born to a father "senior manager and professional" or "technician and associate professional" and "armed forces" are more likely to report a good health status than respondents born to "skilled agricultural and fishery workers", "craftsmen and skilled workers" or "elementary occupations and unskilled workers". The KS unilateral tests in table I confirm the existence of inequalities of opportunity in health according to the father's social status. Moreover, the results show that the distribution of health in adulthood of respondents born to an office clerk or a service worker significantly dominates the one of those born to an unskilled worker.

The results are similar for mothers (cf. fig. 4-B and table I). The distribution of health status of individuals born to a mother either "senior managers, professionals and technicians" or "office clerks and service workers" significantly dominates the distribution of health of those born to a mother from any other social category. Therefore, descendant's health is better if his mother had a higher socioeconomic position.

Figure 4 and table I about here

[10] Results available in Trannoy and colleagues' working paper (Trannoy et al. 2008).

This non-parametric approach shows the existence of inequalities of opportunity in health according to social background and to a lesser extent, according to parents' health, which represent circumstances independent from individual responsibility.

Results of the parametric approach

The results of the estimation of equations (1a), (1b) and (1c) are presented in table II and are interpreted in terms of proportional odds ratios. As expected, the probability to have a better SAH strongly reduces with age but there are no significant differences by gender in the three models.

Table II about here

Influence of social background and parents' relative longevity

The model (1a) shows that the probability of self-assessing better health in adulthood increases with parents' SES. An individual born to a father who was either "senior manager and professional", "technician and associate professional", in "armed forces" or "office clerks and service workers", has a significantly higher probability of better health status than those whose father has an elementary occupation, after adjusting for age and gender. These results exactly match with the dominance approach. As for mothers, a respondent whose mother had an elementary occupation always has a lower probability of better health in adulthood than someone born to a homemaker. Moreover, individuals born to parents who had a higher relative longevity are significantly more likely to report better health. It is also true for individuals whose father is still alive. There is in fact a selection effect more than a gender effect: the proportion of still alive fathers is smaller than the proportion of mothers, so the fact to have a father alive provides more information on health status.

Influence of social background, parents' relative longevity and current socioeconomic status

In the second model, we observe, *ceteris paribus,* that education significantly influences health status: the higher the education level, the higher the likelihood of better health. In addition, the introduction of education level modifies previous results: the effect of the fathers' SES on descendant's health is removed. It is thus an indirect effect and comes from the respondent's education level, which reminds the *pathway model*. On the contrary, the influence of mothers' SES on health in adulthood persists: by comparison to children of homemakers, there is a positive and significant impact on health status of individuals born to a mother who was "office clerks" or "shop and market sales workers" and, a negative and significant impact for individuals born to mothers in elementary occupations. This impact is direct, i.e. independent from the effect of social background on respondent's education and can be interpreted as either being the influence of living standards in childhood on health or the influence of mothers' education level on education to health.

Parents' health still influences health status in adulthood; an individual whose parents had a higher longevity significantly is in better health. Nevertheless, the introduction of education reduces both the significance and the value of odds ratios related to parents' health, particularly those associated to the mother's longevity. This result suggests that education could reduce the influence of parents' health, i.e. the intergenerational transmission of health. A higher education level would thus be able to protect health because of a lower reproduction of poor family habits or an improved awareness of health transmitted difficulties such as genetic screening.

Individual's SES is introduced in the third model and found to influence significantly SAH[11]. Individuals who are "senior managers and professionals", "technicians and associate professionals and armed forces", "office clerks service workers" and "skilled agricultural and fishery workers" are more likely to report a better health status than individuals having elementary occupations and being unskilled workers. Results concerning parents' SES are similar to the previous model. Fathers' SES does not directly influence descendants' health

[11] Socioeconomic status is theoretically not found to be an exogeneous variable (Smith 1999). It is thus tricky to interpret that result as a causal effect of current SES on health. However, a previous analysis using instrumental variables showed that the exogeneity of SES could not be rejected (Devaux et al. 2008).

whereas having a mother in elementary occupations or unskilled workers significantly reduces chances to report a better health status.

Finally, this model removes the significant effect of the father's relative longevity but confirms the effect of the mother's relative longevity and the father's vital status on health in adulthood.

Magnitude of the impact of circumstances on inequalities of opportunity in health

We evaluate the magnitude of the inequalities of opportunity in health estimating the system of equations (2). Results are presented in table III.

Table III about here

The two reduced equations show that current SES, as measured by education level and social status is significantly influenced by childhood circumstances. Fathers' SES similarly influences education level and social status: individuals born to a father, who had a higher professional status (i.e. office clerks and higher) have both a stronger probability to have high education and a higher probability to have high social status than those born to an unskilled worker. Mothers' social status also influences the probability of having better socioeconomic characteristics. Individuals born to a senior manager mother have a higher probability of having both high education and high social status than individuals born to a homemaker, whereas it is the contrary for individuals born to a mother who worked in agriculture. They indeed have a lower probability of both high education and high social status than homemakers' descendants. Moreover, individuals born to office clerks mothers are also more likely to have high social status than individuals born to homemakers. Considering the probability of having high education, individuals born to a mother in elementary occupations are more likely to be socially disadvantaged than individuals born to homemakers. Mothers' longevity as well as their vital status significantly increases the probability of having both high education and high social status. As for father's health, education is positively and significantly influenced by the relative longevity whereas the probability of higher social status significantly increases with the father's vital status. These findings are in acquaintance with the view that parents with low longevity expectations might be reluctant to invest in their offspring's human capital. Furthermore, the generalised residual of the education equation significantly and positively influences the probability of having high social status. This coefficient can be interpreted as the influence of education on SES independently from social background.

Finally, the odds ratios of the third estimation reported in table III show the global impact of childhood circumstances on health status in adulthood. It is striking that the odds ratio of the third column of table III and of the first column of table II on circumstance variables are almost the same. It shows that the Frisch-Waugh theorem is almost valid on our dataset, despite the non-linearity of the model. So we will not comment the results again. This estimation yields new insights into the impact of the two residuals terms of the reduced equations. It shows the significant effects of individuals' achievements in education and in SES on health whatever the circumstances. Ascending trajectories have an impact on health, controlling for parental SES. Therefore, efforts and luck for a higher education as well as efforts and luck in social status increase the probability of having a better health status in adulthood. Moreover, we notice that the odds ratio associated to efforts and luck in education is higher than the one of efforts and luck in social status, which would emphasise the specific role of education to secure a better health status. However, the significance of the two residuals terms could also be explained by a reverse impact of individual health on education achievement or social status.

We then quantify the impact of childhood circumstances on the level of inequality in health using the predicted probability of having a good or very good SAH in that last equation and the Gini or Erreygers coefficients.

The distribution of the probability of being in good health among descendants exhibits a Gini coefficient equal to 15.5 points. This value is compared to five other values resulting from levelling up circumstances for the whole sample. If all descendants had been fortunate enough to grow up with the best circumstances, which means according to the model (2.c) that they have both parents alive, a senior manager father and an office clerk mother, then the Gini coefficient decreases by almost 60% and equals only 6.5 points (see table IV). We thus find that the inequality in childhood circumstances is a major factor for explaining inequality in health in the sense that differences in health would have been much lower if circumstances were the same for any individual. The other counterfactual hypotheses aim to show accurately which initial conditions matter the most among parents' health or social background. If we concentrate on the effect of fathers' characteristics as compared to mothers' characteristics, the Gini coefficient reduces by 6 points when fathers' best circumstances are allocated whereas it decreases by 4 points for mothers' best circumstances. Therefore, the level of inequality in health reduces more when individuals have the best circumstances in fathers' characteristics than when they have the best circumstances in mothers' characteristics.

Moreover within the transmission of health inequalities, socioeconomic issues seem to be more important than health issues for descendants. If all the parents were alive then the reduction of the Gini coefficient would equal 4.5 points, whereas if all the descendants were born to the best social background then the reduction would be of 6 points. The relative magnitude of the changes in inequality is roughly similar for all counterfactual exercises regardless of the inequality index we used, namely the Gini or the Erreygers index. Therefore, the level of inequality in health is more influenced by social circumstances than circumstances of health in childhood.

5. Discussion

This analysis shows inequalities of opportunity in health for older adults according to social background and parents' longevity. Consistent with previous literature (Currie and Hyson 1999; Elstad 2005; Power and Hertzman 1997), fathers' SES has a long-term effect on health in adulthood. Our study also provides original results on the correlation of health across generations and the impact of mothers' SES on health in later ages.

These results are obtained using two complementary approaches. The non-parametric one gives very robust results in terms of stochastic dominance at first-order whereas the parametric approach confirms and refines results by reasoning *ceteris paribus*.

First of all, mothers' SES is found to have a direct effect on health status of descendants in older ages, which is coherent with the *latency hypothesis*. Fathers' SES only has an indirect effect through the descendant's education level and socioeconomic status in accordance with the *pathway hypothesis*. Moreover, the hypothesis of *transmission of health from one generation to the next* holds as there is a direct effect of fathers' vital status and of mothers' relative longevity on descendants' health in adulthood. As a consequence, the three channels identified in the literature through which family background can influence health in adulthood are involved in the explanation of inequalities of opportunity in health in France.

Finally, the counterfactual analysis permits understanding the effect of differences in circumstances on inequality in health. It shows that childhood circumstances increase health inequalities, and do so strongly: inequality - as measured by the Gini index - would be more than halved where the effects of individual circumstances are removed. Furthermore, among circumstances, social aspects and fathers' characteristics are found to have the highest impact on the level of equality of opportunity in health. This result advocates the need to neutralise the effect of these circumstances. It may help in identifying priorities in terms of the most important background characteristics for reducing inequality of opportunity in health.

The use of SAH to measure the respondent's health could be criticised as this variable may suffer from individual reporting heterogeneity (Bago d'Uva et al. 2008). Nevertheless, a French study shows that SAH is the least biased health indicator as compared to several other indicators (Devaux et al. 2008).

As for parents' health, it would have been preferred to have other health measures, particularly the health status of the parents during childhood. Moreover, the estimation of their year of birth introduces a measurement error on their relative longevity. Nevertheless, this error does not jeopardise our conclusions because it is likely to be randomly distributed.

Data do not permit disentangling whether transmission of health is due to genetic inheritance, copying parental behaviour, influence of parental health status on investment in children's health capital, or lack of support due to parent's health problems or premature death. This question is yet of importance in an analysis of inequalities of opportunity since from a policy point of view, inequalities due to genes will not be equivalent to inequalities in social background (Lefranc et al. 2006). Furthermore, the effect of parents' health could also be explained by a common family characteristic influencing the health status of all the members in the family. For example, a similar exposure to either a risky geographical environment (radioactive and environmental pollutions) or a sanitary risk or a socially disadvantaged context would suggest similar health statuses within a family.

More importantly, the use of parents' social background at the end of their career introduces an underestimation of inequality of opportunity. Social mobility during professional career is indeed more likely to be upward, particularly for those cohorts who have experienced the "post-war boom". Finally extending this approach to other countries using specific health survey would allow checking the robustness of the results displayed here and will provide an avenue for further research.

6. References

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7. Figures

Figure 1: Distribution of respondents' self-assessed health

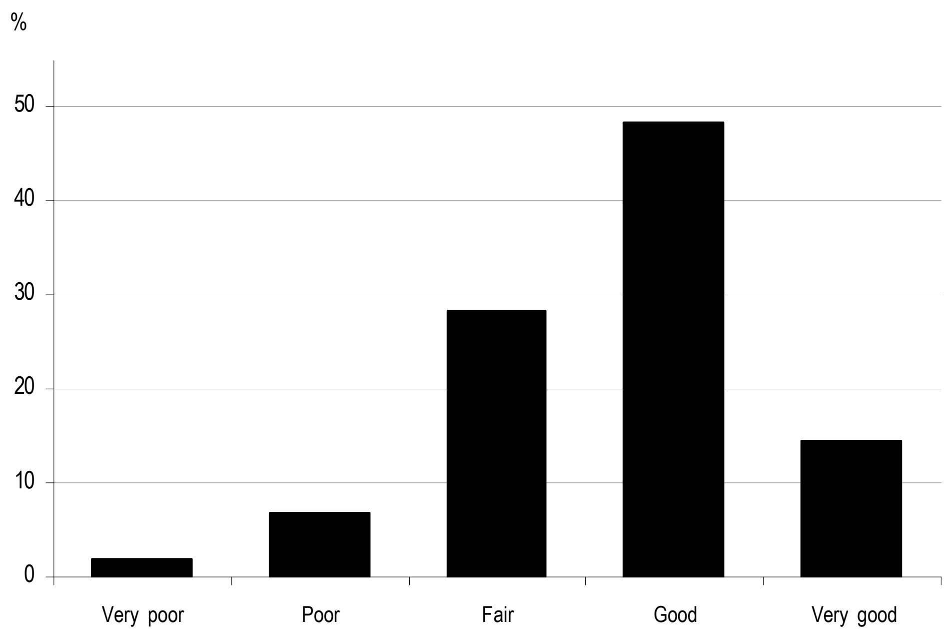
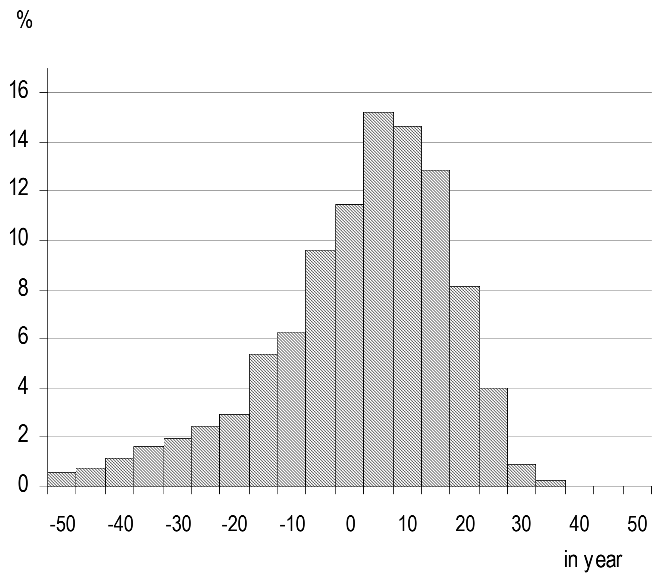


Figure 2: Distribution of deceased parents' relative longevity

A. Father



B. Mother

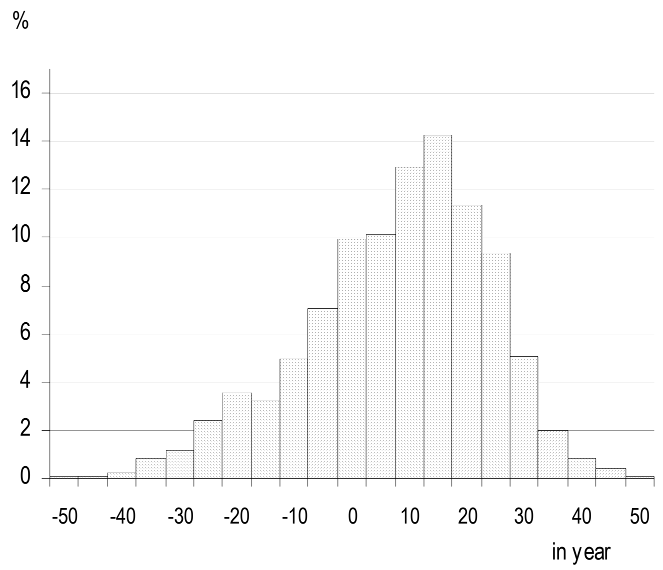
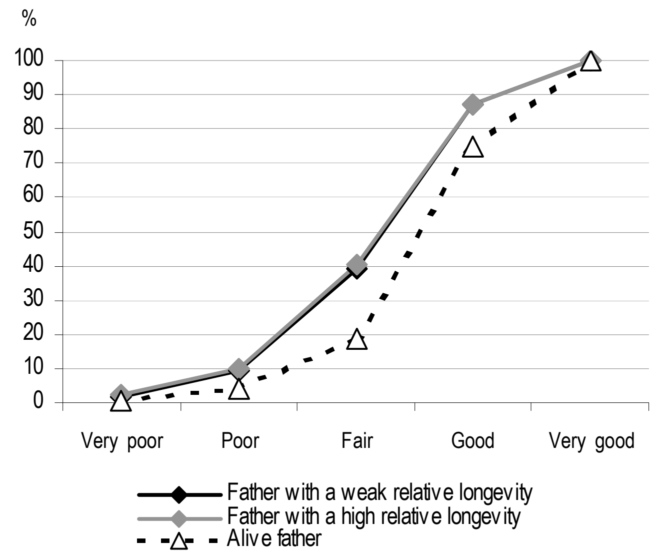


Figure 3: Cumulative distribution functions of self-assessed health according to parents' health

A. According to fathers' health



B. According to mothers' health

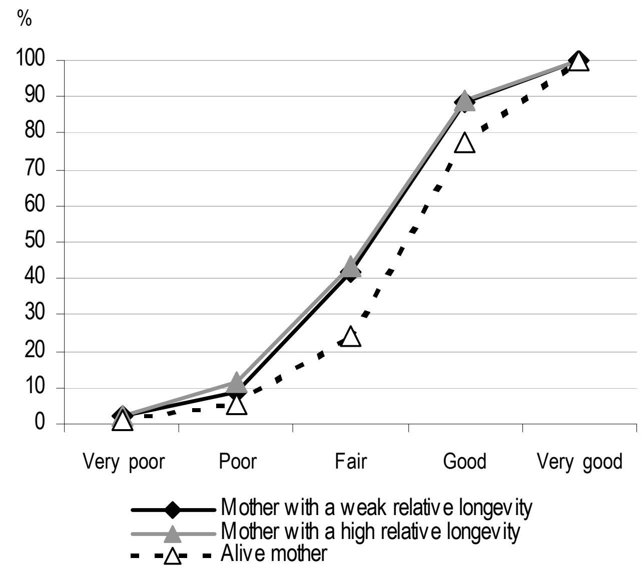
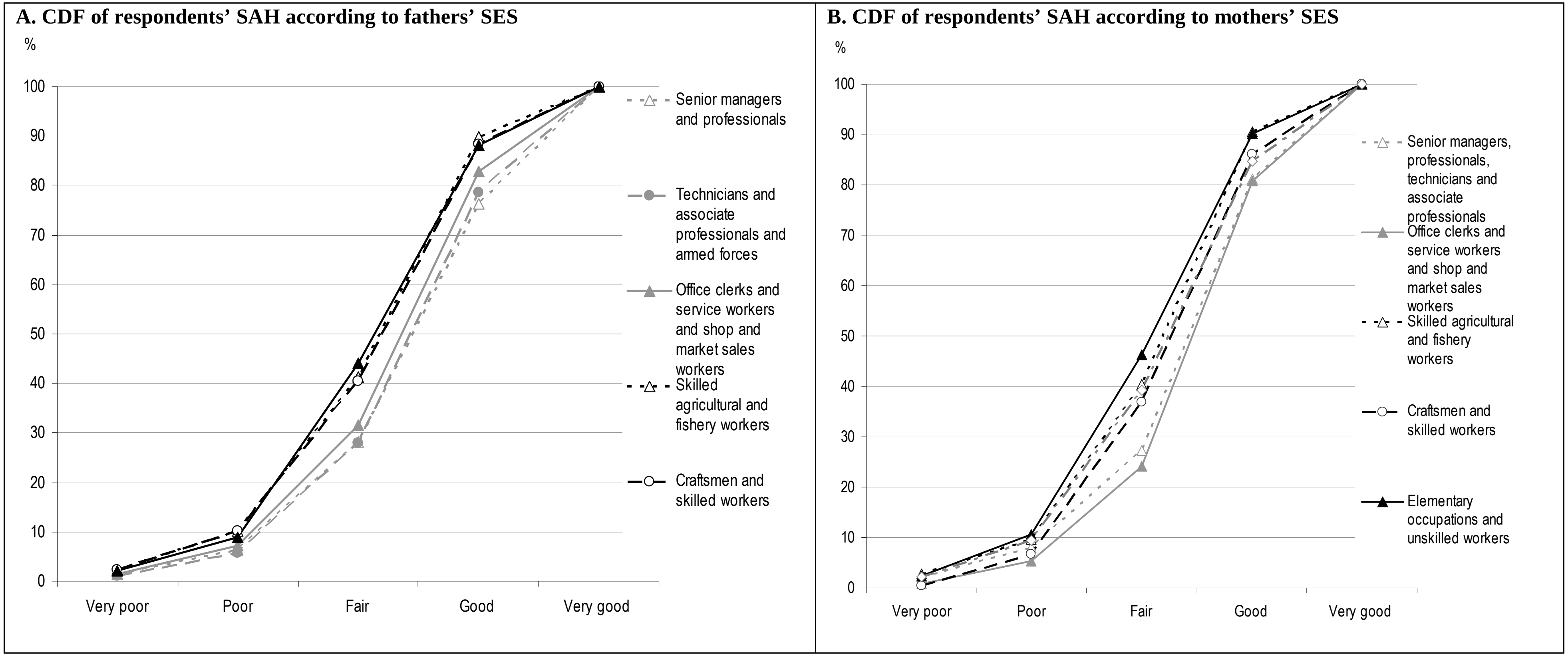


Figure 4: Cumulative distribution functions of self-assessed health according to social background



8. Tables

Table I: P-values of homogeneity tests of distributions of respondents' self-assessed health according to social background

Fathers' occupation	Senior managers and professionals	Technicians and associate professionals and armed forces	Office clerks and service workers and shop and market sales workers	Skilled agricultural and fishery workers	Craftsmen and skilled workers	Elementary occupations and unskilled workers
Senior managers and professionals		0,8544	0,3389	0,0001	0,0002	0,0013
Technicians and associate professionals and armed forces	0,9888		0,6676	0,0012	0,0014	0,0029
Office clerks and service workers and shop and market sales workers	1	1		0,056	0,073	0,0459
Skilled agricultural and fishery workers	1	1	1		1	0,7986
Craftsmen and skilled workers	1	1	1	0,8292		0,6544
Elementary occupations and unskilled workers	1	1	1	0,9053	0,9475	

Mothers' occupation	Senior managers, professionals, technicians and associate professionals	Office clerks and service workers and shop and market sales workers	Skilled agricultural and fishery workers	Craftsmen and skilled workers	Elementary occupations and unskilled workers	Homemakers
Senior managers, professionals, technicians and associate professionals		1	0,0049	0,1117	<0,0001	0,0017
Office clerks and service workers and shop and market sales workers	0,7545		0,0002	0,0185	<0,0001	<0,0001
Skilled agricultural and fishery workers	1	1		1	0,3424	1
Craftsmen and skilled workers	0,9266	0,9983	0,5696		0,1166	0,7592
Elementary occupations and unskilled workers	1	1	0,9953	1		1
Homemakers	1	1	0,1453	0,9379	0,1248	

Table II: Odds ratio associated to the determinants of the probability to report a better health status

Explanatory variables	Freq.	Model (1a)	Model (1b)	Model (1c)
Gender				
Woman	1475	1,042	1,126	1,129
Man	1191	ref	ref	ref
Age				
49-54	586	4,901***	3,917***	4,27***
55-59	515	5,498***	4,415***	4,731***
60-64	364	3,937***	3,411***	3,613***
65-69	339	3,01***	2,642***	2,767***
70-74	325	2,277***	2,173***	2,303***
75-79	259	1,448**	1,427**	1,467**
>=80	278	ref	ref	ref
Fathers' occupation				
Senior managers and professionals	406	1,834***	1,27	1,179
Technicians and associate professionals and armed forces	275	1,779***	1,22	1,122
Office clerks and service workers and shop and market sales workers	197	1,476**	1,165	1,136
Skilled agricultural and fishery workers	625	1,173	1,205	1,194
Craftsmen and skilled workers	970	1,061	0,987	0,985
Elementary occupations and unskilled workers	193	ref	ref	ref
Mothers' occupation				
Senior managers. professionals and technicians	271	1,113	0,942	0,904
Office clerks and service workers and shop and market sales workers	282	1,376**	1,287*	1,219
Skilled agricultural and fishery workers	372	0,937	0,994	1,013
Craft and related trades workers	223	1,139	1,086	1,098
Elementary occupations and unskilled workers	255	0,784*	0,793*	0,796*
Homemakers	1263	ref	ref	ref
Fathers' longevity				
Relative longevity of deceased father	2316	1,007***	1,005*	1,004
Alive father	350	1,402***	1,37**	1,349**
Mothers' longevity				
Relative longevity of deceased mother	1862	1,008**	1,005*	1,005*
Alive mother	794	1,164	1,076	1,063
Education level				
No diploma	494		Ref	ref
Elementary level diploma	694		1,589***	1,468***
Secondary level diplomas	823		1,989***	1,608***
Baccalauréat (A-levels)	655		4,171***	2,742***
Descendants' occupation				
Senior managers and professionals	468			2,32***
Technicians and associate professionals and armed forces	552			2,127***
Office clerks and service workers and shop and market sales workers	588			1,642***
Skilled agricultural and fishery workers	167			1,473**
Craftsmen and skilled workers	467			1,129
Elementary occupations and unskilled workers	266			ref
Homemakers	158			1,206
Model quality				
Score Test for the Proportional Odds Assumption (P-value)		0.109	0.091	0.164
AIC (intercept only 6670.075)		6362.16	6246.43	6216.12
Adjusted R2		0.134	0.177	0.191
Percent Concordant pairs		66.2	68.7	69.7
N		2666	2666	2666

Note: The score test confirms that the ordered Logit is an appropriate specification and the percentage of concordant pairs which is higher than 65% shows the quality of the model (Allison 1999).

Table III: Results of the estimation of the three equations model with incorporated residual terms

	Model (2a)	Model (2b)	Model (2c)
	Probability to have a higher educational level (binary variable)	**Probability to have a higher social status (binary variable)**	**Probability to be in better health status (ordinal variable)**
	Binary Probit	**Binary Probit**	**Ordered polytomous Logit**
Explanatory variables	**Coefficient**	**Coefficient**	**O.R.**
Gender			
Woman	-0,116***	-0,2832***	1,037
Man	ref	ref	ref
Age			
49-54	0,703***	-0,026	5,064***
55-59	0,734***	-0,026	5,710***
60-64	0,524***	0,079	4,079***
65-69	0,407***	0,0136	3,079***
70-74	-0,003	-0,1978	2,303***
75-79	0,031	-0,2369*	1,443**
>=80	ref	ref	ref
Fathers' occupation			
Senior managers and professionals	1,09***	1,0295***	1,900***
Technicians and associate professionals and armed forces	1,039***	0,9958***	1,825***
Office clerks and service workers and shop and market	0,545***	0,5386***	1,513**
Skilled agricultural and fishery workers	-0,094	-0,1551	1,173
Craftsmen and skilled workers	0,079	0,1099	1,060
Elementary occupations and unskilled workers	ref	ref	ref
Mothers' occupation			
Senior managers. professionals and technicians	0,291***	0,4342***	1,110
Office clerks and service workers and shop and market	0,036	0,2474***	1,393**
Skilled agricultural and fishery workers	-0,463***	-0,2503**	0,941
Craft and related trades workers	-0,15	-0,0193	1,136
Elementary occupations and unskilled workers	-0,289**	-0,0462	0,777*
Homemakers	ref	ref	ref
Fathers' longevity			
Alive father	0,064	0,2149**	1,411***
Relative longevity of deceased father	0,007***	0,0019	1,007***
Mothers' longevity			
Alive mother	0,204***	0,2218***	1,169
Relative longevity of deceased mother	0,007***	0,00481**	1,008***
Residuals			
Education equation		0,846***	1,685***
Occupation equation			1,376***
Model quality			
AIC (intercept only)	2974,84	3549,49	6670,08
AIC (intercept and covariates)	2404,55	2621,53	6248,24
Adjusted R2	0,305	0,415	0,175
Percent Concordant pairs	80,3	82,6	68,7
Score Test for the Proportional Odds Assumption (P-value)			0,17
N	2666	2666	2666

Note: The score test confirms that the ordered Logit is an appropriate specification and the percentage of concordant pairs which is equal to 65% shows the quality of the model

Table IV: Results of the counterfactual analysis

Variables used for predicting the probability of having better health (ordered polytomous Logit)	Mean probability of good or very good health	Gini index	% of variation (Gini index)	Erreygers index	% of variation (Erreygers index)
Current characteristics	0,633	0,155		0,392	
With the best circumstances	0,825	0,066	-57,275	0,218	-44,504
With the best fathers' characteristics	0,760	0,095	-38,818	0,289	-26,413
With the best mothers' characteristics	0,717	0,114	-26,707	0,327	-16,692
With the best parents' occupation	0,767	0,092	-41,045	0,282	-28,080
With alive parents	0,709	0,119	-23,676	0,337	-14,008