UNDERSTANDING THE EFFECT OF EDUCATION ON HEALTH ACROSS EUROPEAN COUNTRIES (*)

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ABSTRACT

In this piece of work we explore the link between education and health in eleven European Union countries. We compute country-specific health production functions following Grossman's human capital approach where education is one of the main inputs. Our empirical strategy, a set of generalised (cross section and random effects) ordered *probit* models on a sample of wage earners has enabled us to distinguish in a very detailed way positive returns of both upper secondary and tertiary education on health. We observe positive (and usually decreasing) returns to education in terms of health improvements in all the selected countries, although the level of return rates vary across countries.

Keywords: health production function, non monetary returns to education, generalised ordered *probit* model.

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1. INTRODUCTION

This study is aimed at analysing the relations between health and education in different countries of the European Union. Several channels connect these variables, which we may explore by answering two questions. The first one would be "which are the effects of health on education?" The answer to this question requires studying the impact of improvements of health on educational achievements of individuals –normally in the early ages– and on future income, either during working life or even during retirement (Case *et al.*, 2002, Currie and Stabile, 2004 and Case *et al*., 2005). The second question would be: "which are the effects of education on health?" Answering this question requires studying the impact of education on health status when the individual has already completed her investment in education and entered the labour market (Grossman, 1972, Leig, 1983, Kendel, 1991, Arendt, 2005). In this study we focus our attention on the latter question, and to this aim we estimate a health production function where education attainment is one of the main inputs together with several other control variables. The analysis we present here is based exclusively on high income countries. This is not just a nuance, but an important issue: first, unlike developing countries, European Union is conformed by countries where the level of education is "acceptable" and relevant improvements in the educational attainment are unlikely to happen. Therefore we may only expect small improvements in the educational attainment of the population to have a marginal impact on health. Still, the European Union has ambitious targets as regards educational attainment of the population: the Lisbon Summit defined a target consisting in increasing up to 80% the percentage of 18-24 year-olds with a secondary education attainment (ISCED-3) by 2010. Achieving this target will entail different levels of effort across countries[1]. In this piece of work we will try to define guidelines about the extent to which this effort on education will have an effect on health of European citizens. This effect may be included amongst non monetary benefits from education (see Grossman 2005 for a survey on the non market effects of education). If education entails non monetary as well as monetary rewards, the return rate of education (defined with market criteria) is underestimated. This underestimation arises from externalities from education. Although these externalities are difficult to measure, it is also difficult to deny their existence.

Empirical evidence on the relation between education and health is quite rich, although it does not equally cover all countries in the European Union. Literature for the US is quite spread whereas pieces of work either on Europe or on different

[1] Early school leavers in 2005 account for 38,6% in Portugal and 12,6% in France. Spain registers an intermediate level of drop-outs (30,8%). The interested reader may consult this information in Eurostat webpage.

European countries are rather scarce. Exceptions are those based in Denmark (Wagstaff, 1986, 1993), East Germany (Erbsland et al, 1995 and Pohlmeier and Ulrich, 1995), Great Britain (Contoyannis *et al*, 2004), The Netherlands (Hartog and Oosterbeek, 1998), Spain (Albert and Davia, 2004) and Sweden (Gerdtham and Johannesson, 1999 and Bolin *et al*, 2002). Comparative analyses are even scarcer[2], and so far they have been hindered by the lack of the suitable comparable information. We try to enrich this strand of the literature by contributing with results for the link between health and education in eleven European Union countries.

In this study we will deploy the European Community Household Panel (ECHP) from 1994 to 2001. This data set gathers very interesting information about health variables, education and labour market issues amongst other aspects, such as income. The ECHP offers a possibility to compare countries, although it is not free of limitations. They arise from differences between the national questionnaires as regards health questions, which are more pronounced than differences in other parts of the questionnaire. Moreover, the questions about health have changed along the observation period, particularly from the fifth interview onwards. Since our contribution is to obtain a health production function for as many countries (and waves) as possible, we have chosen eleven of the European Union countries where there are eight waves of available information. This strategy has implied renouncing to several explanatory variables in the estimation of the health production function[3], although we think this has been worth doing for two reasons: on the one hand, our analysis enables the comparison of the effect of education level on health in eleven countries; on the other hand we may use panel data methodologies, namely, a random effects ordered *probit*. With this technique we may take into account the potential impact unobserved heterogeneity, which is very relevant in the study of health determinants and health outcomes. We have computed a log-likelihood test to contrast the increase in the goodness of fit of the model when including this particular nuance. Results of the test –available at the end of table A1 in the appendix– showed that, with no exception, the inclusion of individual random effects significantly contribute to the goodness of fit of the models, so that trust more random effect specification.

The contents of the article are as follows: after a survey of theoretical and empirical approaches to the study of the effect of education on health, we proceed to

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[2] Amongst comparative pieces of work where health production functions are estimated we may mention Hurd and Kapteyn (2003) where the American and the Dutch cases are compared. Van Doorslaer and Koolman (2004) is also worth mentioning; they compare fifteen European countries using the 1996 wave of the European Community Household Panel. Anyway, none of these pieces of work is focused on the link between education and health.

[3] In Appendix B the interested reader may observe the lack of homogeneity in education and health related variables across countries and waves and how including a single additional explanatory variable implies renouncing to countries or to waves.

present the database, our empirical model and the main results of the empirical strategy. We conclude by summarising the main findings of our paper and proposing further research to be done in the future. At the end of the document the reader may consult appendices A and B. Appendix A displays tables not included in the text. Appendix B consists on a revision of homogeneity problems in the ECHP as regards education and health (our main variables), across countries and waves.

2. THE EFFECT OF EDUCATION ON HEALTH

Health economists have tried to understand the positive link between education and health and empirical analysis has confirmed it once and again exploring three hypotheses[4]: productive efficiency, allocative efficiency and the time preference hypotheses. The productive efficiency and allocative efficiency hypothesis predict a causal relation between education attainment and health (Grossman 1972). In the former hypothesis, this link is due to the fact that educated agents will be more efficient in the use of health care services and, therefore, in the production of health. One of the main problems to contrast this hypothesis is that both education and income are relevant inputs in a health production function, but income does depend as well on education. Therefore income is an endogenous variable in a single equation health production function. In order to tackle this endogeneity, two approaches are available: instrumental variables and simultaneous equations. For instrumental variables Grossman (2004) display a survey of recent contributions to this type of literature and for a simultaneous equation approach, see Lee (1982).

In the second approach (allocative efficiency hypothesis) education is seen as a driving force (similar to a catalyst) in health related decisions. Educated individuals are more aware of the consequences of unhealthy habits and will tend to invest more time and resources on health care. Therefore, we might expect a direct effect of education on health. One way to test this hypothesis would consist in observing whether the education coefficient tends to be lose explanatory power as we include more and more inputs in the health production function (Rosenzweig and Schultz, 1989).

In the third approach, the time preference hypothesis, those agents with a low time discount rate who prefer future consumption to present consumption tend to invest more resources on human capital (on both education and health), so that the positive link between both variables is not causal (Fuch, 1982 and Farrell and Fuchs, 1982). Unfortunately it is difficult to contrast this hypothesis, since time preference is not the only omitted variable we may have in a health produc-

[4] Grossman (1999 and 2005) display a very rich literature survey on these topics.

tion function. Contrasting this hypothesis is very difficult since time preference is not easy to measure. Different authors have made use of instrumental variables as an empirical strategy to control for time preference; they have tried to find a valid instrument, i.e., a variable that is linked to health and not to education. Needless to say, this is a particularly challenging endeavour (Grossman, 2004).

No matter the chosen technique, most of the empirical pieces of work on this area conclude that formal completed schooling is the most important correlate of good health. This finding emerges regardless both the way of measuring health levels and the units of observation (individuals or groups). Another interesting result suggests that schooling is a more important correlate of health than occupation or income. As the allocative efficiency hypothesis stresses, schooling is a causal determinant of occupation and income, so that the "gross" effect of schooling on health may partially reflect its impact on the socioeconomic status.

We do not distinguish between the productive efficiency and the allocation efficiency hypothesis here since they are observationally equivalent although we will use panel data techniques that encounter for unobserved heterogeneity, be time preference one of the unobserved traits in our model. Our theoretical framework will be Grossman (1972) human capital model. It has been categorised as part of the human capital approach because it follows a very similar perspective to the one adopted by Becker to explain investments in education: individuals wish to maximise their income along the life course. To this aim they will choose an optimal investment on human capital, which includes as well investment on health. Health is a special good: it may not be directly purchased in the market, but the individual "produces" it through several inputs from an initial stock. Besides, in the decision about investment on health the degree of depreciation of the stock of health must be also taken into account. The elder the individual, the more expensive will be to achieve a given improvement in health status, since their health capital will rapidly depreciate. Summarising, Grossman's model presents education as an efficiency enhancing element in the investment on health (either improving the use of health care and healthy inputs, or making right choices about healthy habits or in both ways at the same time), this would be a non monetary return to education, which should be added to the already well-known monetary return (*i. e.*, wages).

3. THE DATA

In this paper we deploy the European Community Household Panel (ECHP). It is a survey based on a standardised questionnaire that involved annual interviewing of a representative panel of households and individuals in each European Union country, covering a wide range of topics: income, health, education, housing, demographic and employment characteristic, etc. The total duration of the ECHP was 8 years,

running from 1994 to 2001. In the first wave, *i. e.* in 1994, a sample of some 60,500 nationally represented households (*i. e.* approximately 130,000 adults aged 16 years and over) were interviewed in the then 12 Member States. Austria (1995) and Finland (1996) were late joiners. Data for Germany and United Kingdom are derived from the own national Living Conditions Survey and transformed into ECHP format. Something similar happens as well in Luxembourg (available from 1995) and Sweden (available from 1997)[5]. Moreover, the Swedish contribution to the ECHP is not a proper panel, having been extracted from a repeated cross-sectional survey.

The dependent variable in our analysis is a subjective measure of health. The question in the questionnaire read: How is your health in general?[6] and the individuals could choose between five different categories: "very good", "good", "fair", "bad" or "very bad". This indicator, being a self-evaluation of health may reflect different perceptions for each individual. That is to say, the terms "very good" or "very bad" could have a different meaning for each individual. It can be considered a problem because it hinders comparisons among the individuals, although we do not see it as an inconvenience. In fact, health status is not directly observed and it is related to individual self-perception. This is what in fact our indicator of self-evaluation of health detects. Ilder and Kasl (1995) showed that the subjective health indicator was correlated with the risk of disability and morbidity, and once the baseline functional ability and socio demographic status were controlled for, subjective health indicators predict future levels of functional disability and have shown themselves to be potent predictors of mortality.

The analysis performed in this paper covers eleven from the 15 European Union countries[7] included in the ECHP in 1994: Denmark, Germany, The Netherlands, Belgium, France, United Kingdom, Ireland, Italy, Greece, Spain and Portugal. The independent variables used in the analysis are, besides educational attainment[8] and

[5] The PSEL in Sweden, SOEP in Germany and BHPS United Kingdom.

[6] The answer in France was made using a 1 to 6 Laeken scale. It was later harmonised to the five categories available in the rest of countries.

[7] Luxembourg may not be included in the analysis since it is not provided with a self-reported health status variable.

[8] The educational attainment variable available in the data has only three values: 1 for higher education graduates (ISCED 5 to 7), 2 for second stage of secondary education graduates (ISCED 3) and 3 for those who have not reached that level (ISCED 0 to 2). We have nevertheless observed several problems in terms of lack of homogeneity in answers through time in The Netherlands and France. In the Netherlands, from the fifth wave onwards some interviewees transit from tertiary and secondary education to the lowest levels. In France, from the sixth wave onwards we may see a transfer of individuals from the lowest level of education to the intermediate one. Given these inconsistencies, in these two countries we have finally allocated the level of education reported in the first interview to the rest of the interviews. As a result, the distribution of the population across different education levels remains quite similar to the one published by the OECD.

gross hourly wages[9], working hours, age, gender, and living alone. It is important to remind here that the aim of our work is to obtain comparable and homogeneous estimations of health across countries, and to gather as many waves as possible so that we may control for unobserved heterogeneity using panel data techniques.

We are thus provided with eight waves and we have analysed them both as a pooled data when using cross-section techniques, and as an unbalanced panel in the random effects *probit* model. The sample is restricted to 25-64 wage earners[10] who work more than 15 weekly hours which provided with valid values in all the relevant variables in the analysis.

Table 1 shows the basic descriptive statistics for the whole sample[11]. Germany contributes with more observations than any other country, whereas Irish and Greek samples are the smallest ones. There are more men than women in the sample, and only 7.2% lived alone in the moment of the interview. As regards the educational attainment, 28% report having tertiary education, 37.5% report secondary education and 34.4% do not reach complete second stage of secondary education. The average age of the interviewees is 40.4 years[12].

Table 1

DESCRIPTIVE STATISTICS (*POOL* OF COUNTRIES)

	Mean	**Standard Deviation**
Age	40.4	9.8
Wage (PPPs, gross, monthly)	2126.3	8909.8
Working hours (week)	38.6	11.4
	Frequency (weighted)	**Percentage**
Self-reported health status		
Very good	1196875	18.3
Good	3384512	51.8
Fair	1576056	24.1
Bad	319818	4.9
Very bad	55067	0.8

(*Keep.*)

[9] In order to obtain comparable results, we have expressed net hourly wages in PPS €.

[10] This enables the inclusion of two of the most relevant variables in the study of returns to education: wage and hours of work.

[11] The size of the simple is not directly proportional to the size of the population in each country, since each country has a different sampling system in such a way that samples would be representative of the population in all of them.

[12] The descriptive statistics for the specific country samples are not displayed for the sake of brevity but are available from the authors upon request.

(*Continuation*.)

	Frequency (weighted)	Percentage
Education Level		
Tertiary (ISCED 5-7)	1926306	29.5
Upper secondary (ISCED 3)	2617145	40.1
Less than upper secondary ((ISCED 0-2)	1988877	30.4
Gender		
Male	3619783	55.4
Female	2912546	44.6
Age		
25-29	1031297	15.8
30-34	1122755	17.2
35-39	1090243	16.7
40-44	1008710	15.4
45-49	915109	14.0
50-54	736222	11.3
55-59	467111	7.2
60-64	160881	2.5
Country		
Germany	1908473	29.2
Denmark	132821	2.0
The Netherlands	349802	5.4
Belgium	188208	2.9
France	1006836	15.4
UK	1133993	17.4
Ireland	49818	0.8
Italy	904519	13.8
Greece	118905	1.8
Spain	576407	8.8
Portugal	162547	2.5
Wave		
1994	767493	11.7
1995	787813	12.1
1996	798966	12.2
1997	804435	12.3
1998	809013	12.4
1999	831270	12.7
2000	856787	13.1
2001	876551	13.4
Total	6532328	

Figure 1 represents, in each country, the proportion of tertiary education graduates against the proportion of interviewees who report being in a very good health status. It may be seen there that those countries with a higher proportion of higher education graduates register as well a higher proportion of interviewees who report feeling very well. The link between education and health may be positive in all countries, but intensity differ considerable across countries: Germany, The Netherlands, France and Spain register a similar proportion of university graduates than Ireland, Denmark and Greece, but the gap in terms of health is remarkable. We do not observe any North-South pattern in the link between education and health. It seems that geographical and cultural proximities are not the key matter here.

Figure 1

PROPORTION OF TERTIARY (ISCED 5-6) EDUCATION GRADUATES AGAINST PROPORTION OF THOSE WHO FEEL THEIR HEALTH IS VERY GOOD

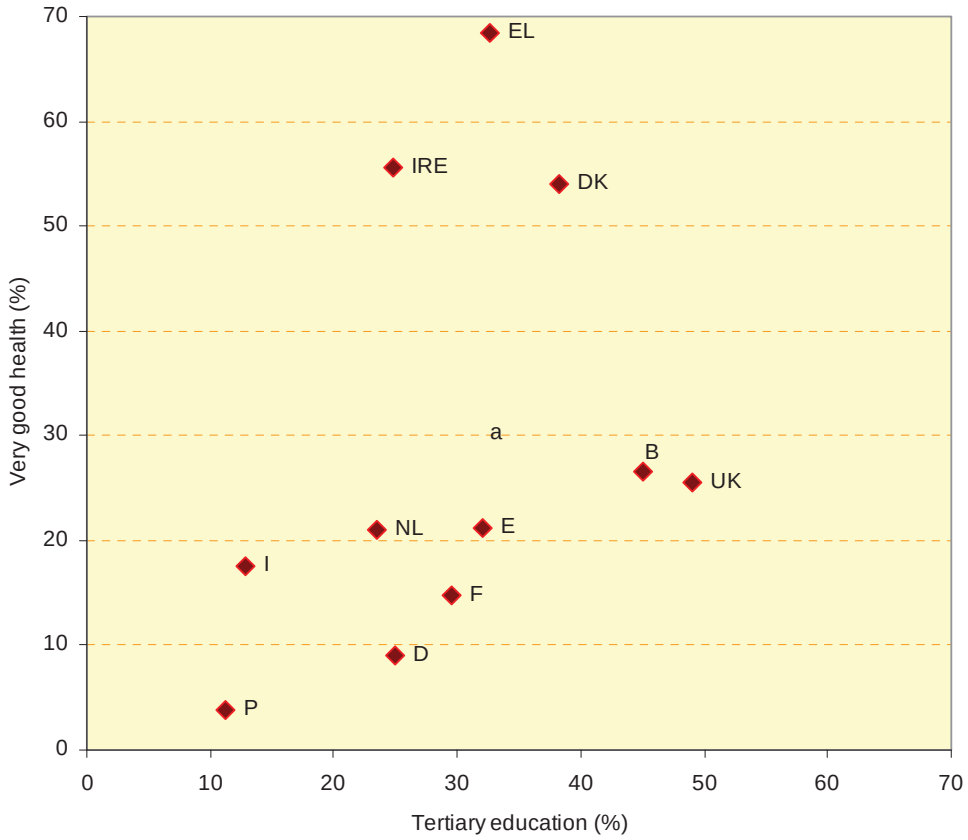
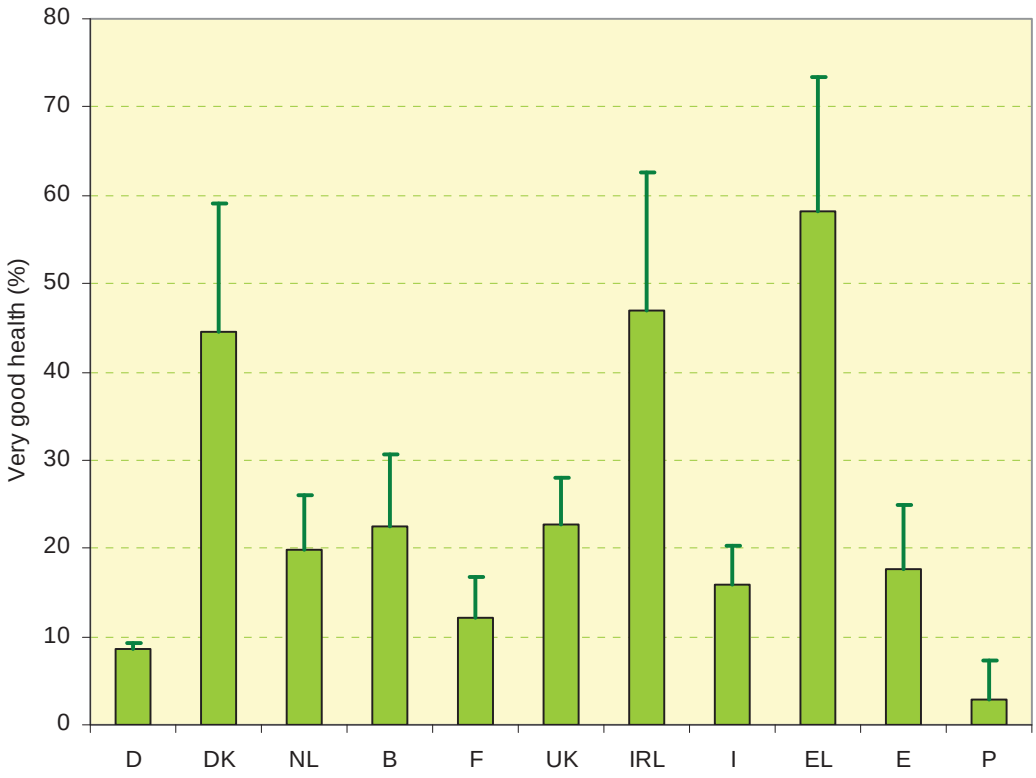


Figure 2 presents the proportion of tertiary education graduates who feel very well and proportion of low tertiary workers who feel very well. The bar represents the proportion of low educated individuals who report feeling very well, and the highest point defines the proportion of university graduates in the same category. The difference between both figures is given by the line that connects the bar with the highest point. We observe a larger absolute difference

in Denmark, Ireland and Greece than in other countries, although relative distance in other countries may be similar (such as Belgium and Spain).

Figure 2

PROPORTION OF TERTIARY EDUCATION GRADUATES (ISCED 5-6) WHO REPORT A VERY GOOD HEALTH (HIGHEST POINT) AND PROPORTION OF LOW QUALIFIED WORKERS (ISCED 5-6) WHO REPORT VERY GOOD HEALTH (GROSS BAR)



Unfortunately, the ECHP is not provided with national institutions indicators. Only individual and household level variables are included. The national health systems are, therefore, not represented in the data-set. In the countries of our study health is provided by a combination of public and private systems. Public systems have in most cases a 100% coverage level, but in some countries the number of citizens that choose a private scheme as well is not negligible. For a complete description of national specificities in health systems, the reader may consult the European Observatory on Health Systems and Policies[13].

4. EMPIRICAL MODEL

We will start by developing a health production function on wage-earners; this model should be interpreted as a reduced form specification of the production

[13] Its web page is http://www.euro.who.int/observatory.

function of health since we are not able to include neither inputs such as health care nor variables regarding healthy habits due to problems with the questionnaire reported in the Appendix. In this model, variable H^*_{it} is a self-assessed health status representing the health stock of individual *i* at time *t*. This variable is a latent unobservable outcome, but we can observe in the data an indicator of the category in which the latent outcome falls (H_{it}); it is an ordered discrete variable taking five values, the actual values taken on by the dependent variable are irrelevant except that larger values are assumed to correspond to "higher" outcomes (health). The observed mechanism can be described in the following way:

$$H_{it} \quad n \qquad \text{if} \qquad \pi_{n-1} < H_t^* \leq \pi_n, \quad n \quad 1,...,m \qquad (1)$$

where π's are called *thresholds* or *cutpoints*. The extreme categories 1 and *m* are defined by open-end intervals with $\pi_0 = -\infty$, $\pi_{\overline{m}} = \infty$, and $\pi_n \leq \pi_{n+1}$.

The probability of observing the self assessed health status *n* for agent *i* in time $t(H_{it})$ is: $P_{itn} = P(H_{it} = n) = \S(\bullet)$, where $\S(\bullet)$ is the standard normal distribution function.

The reduced form model of latent variable can be express by lineal regression structure:

$$H_t^* \quad \beta_0 + \beta_1 Y_i + \beta_2 X_{it} + \beta_4 D_t + u_i + s_{it} \qquad (2)$$

where Y_i is observable time invariant factors (the education level and gender) and X_{it} is the observable time varying factors (the wage, hours of work, age and living alone[14]). We included eight dummy variables (D_t), one for each wave, in order to detect institutional (among other types) changes along time. This derives in a two-way regression model where we may control both dimensions of the problem: time (differences along time within individuals) and "space" (differences across individuals in a given moment of time). Finally, u_i is an individual specific error term; it is assumed to be a random component which will not change over time. s_{it} is a time and individual specific error term and it is assumed to be exogenous, normally distributed and uncorrelated across individuals and along time and with u_i. Finally, β's are parameters to be estimated.

From a human capital approach the expected signs in the relevant coefficients are positive for education and wages and negative for variables representing the depreciation of the stock of health (such as age). There is not a clear hypothesis about the expected sign of gender (women tend to live longer but they also report more health problems than men) and living alone (it may be correlated positively with age for an overall sample of interviewees, but since we restrict our

[14] We have weighted up the inclusion of job related variables but the lack of homogeneity of this variables across countries and waves has deterred us from doing that, since it would have meant renouncing to either waves or countries. It is also worth mentioning that occupation has not being included either since it is affected with more than 10% of missing values in three countries: Denmark, The Netherlands and Belgium.

sample to wage earners, it may be negatively correlated with age, being young workers the most likely to live alone).

Our precise first empirical strategy consists on an ordered *probit* both in a pooled version and with control for random effects. We assumed that the variance of the idiosyncratic error term is restricted to equal one since we do not have a natural scale for the latent variable. When interpreting the results we should keep in mind that the model only identifies $(\pi_{\overline{n}} - \beta_0)$ since we have adopted a conventional normalization setting $\beta_0 = 0$. Therefore u_i (individual effects) cannot be distinguished from an individual specific *cutpoint* shift.

We must here pay attention to a very important nuance: ordered dependent variable models are based on one very relevant assumption, the so called "proportional odds assumption" or the "parallel regression assumption" (Long and Freese, 2006). It consists on assuming that the relationship between each pair of outcome groups is the same. In other words, ordered *probit* (or logistic) regression assumes that the coefficients that describe the relationship between categories 1 and 2 is the same that the one that describes relationship between categories 4 and 5. If this were true, just one set of coefficients would be enough to describe the fitting of the dependent variable. We have tested the proportional odds assumption, via a likelihood ratio test[15]. The null hypothesis of this test is that there is no difference in the coefficients between models, and we widely rejected in all countries.

This means that a standard ordered *probit* model does not properly describe the link between different educational levels and different health statuses, and we need instead a generalized ordered *probit*, both in a pooled version and in a random effects version. We are interested in random effects since they allow us to identify parameters for time-invariant dependent variables. This is precisely the case of education, our most relevant explanatory variable[16]. The generalized model relaxes the parallel regression assumption of standard ordered *probit* models and its random effects counterpart. In these models all the parameters are outcome-specific. This is very interesting for our problem, since we will be able to observe how education contributes both to prevent poor health situations and to access to the highest values of the ranking, that is, we have obtained a different set of coefficients for each outcome. We have led all β_j coefficients free to vary across outcomes. The likelihood contribution for each cross-sectional unit in the above model is approximated using a Gaus-Hermite quadrature (Boes and Wikelman,

[15] The results of the test are available from the authors upon request.

[16] As we study only adult population, our main explanatory variable, education attainment, remains constant in most cases or hardly ever changes. Moreover, as already mentioned, in two countries (namely, The Netherlands and France), because of inconsistencies being detected, we ended up imputing to every individual the education attainment reported in the first interview during all the observation period, which means we have imposed educational attainment to be constant along the observation window.

2006). The ordered *probit* model is estimated using the user-provided commands for generalised pooled order *probit* and generalised random effects ordered *probit* estimators available in STATA[17].

5. RESULTS

Tables 2 and 3 display the results for education attainment variables of our models, the pooled version of the generalised ordered *probit* and the random effects generalised ordered *probit* model for panel data respectively. In order to facilitate the interpretation of the results, we will not provide with the model coefficients but with the estimated marginal probability effects: we are interested on how much the probability of each outcome in the health status distribution responds to a change from 0 to 1 in dummies representing education attainment.

Greene (2003; p 740) asserts that marginal effects for are not appropriate for evaluating the effect of a dummy variable. He recommends instead comparing the probabilities that result when the variable takes its two different values (with each other and with the values that occur with the other variables held at their sample means). Long (1997; p 135) also stressed that measures of discrete change are much more informative than marginal effects.[18] We therefore display results in two different locations: in the text we display marginal effects of binary variables (namely, average probabilities of all the outcomes of our dependent variable) for educational attainment indicators, which are our main explanatory variables. A complete set of the coefficients for the random effects generalized ordered *probit* is available in appendix[19].

For computational reasons we have had to reduce the initially five values in the dependent variable to only four. We have merged values 1 and 2 since a very small number of interviewees reported them and in some models the likelihood function just did not converge. For the sake of consistency, we have estimated as many models as possible with a five value dependent variable as well as the shown four value dependent variable's, and results do not change: categories 3, 4 and 5 remain almost exactly the same regardless the aggregation of values in the dependent variable. Categories 1 and 2 registered always negative or non significant coefficients, so that the reported marginal effects are not the blurred result of different trends, but the summary of a similar effect.

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[17] The random effects specification is estimated using the go*probit* and regoprob commands in STATA, both of them developed by Boes (2006a and 2006b).

[18] For a complete explication on how discrete change are estimated and what they mean, see Greene (2003) and Long (1997).

[19] We do not display the complete set of parameters for the generalised pooled version of the ordered *probit* for space reasons, but they are available from the authors upon request.

Table 2

MARGINAL EFFECTS OF BINARY DEPENDENT EDUCATION VARIABLES ON HEALTH. GENERALISED ORDERED *PROBIT*

	D	DK	NL	B	F	UK	IRE	I	EL	E	P
Bad and very bad (1&2)											
MPE for ISCED 5-7	0.088	0.012	0.013	0.013	0.022	0.052	0.004	0.017	0.004	0.010	0.020
MPE for ISCED 3	0.104	0.014	0.016	0.018	0.029	0.053	0.006	0.025	0.008	0.016	0.019
MPE for ISCED 0-2	0.166	0.029	0.022	0.022	0.047	0.062	0.010	0.047	0.022	0.046	0.086
a) MPE_{ISCED3}-$MPE_{ISCED0-2}$	-0.062	-0.015	-0.007	-0.004	-0.018	-0.009	-0.003	-0.022	-0.013	-0.030	-0.067
b) $MPE_{ISCED5-6}$-$MPE_{ISCED0-2}$	-0.078	-0.017	-0.009	-0.008	-0.025	-0.010	-0.006	-0.029	-0.017	-0.036	-0.066
c) $MPE_{ISCED5-6}$-MPE_{ISCED3}	-0.016	-0.002	-0.002	-0.004	-0.007	-0.001	-0.003	-0.007	-0.004	-0.005	0.001
Fair (3)											
MPE for ISCED 5-7	0.309	0.079	0.128	0.115	0.251	0.183	0.058	0.208	0.033	0.111	0.199
MPE for ISCED 3	0.321	0.115	0.146	0.149	0.267	0.183	0.072	0.227	0.039	0.127	0.212
MPE for ISCED 0-2	0.328	0.168	0.164	0.190	0.317	0.209	0.107	0.291	0.114	0.189	0.343
a) MPE_{ISCED3}-$MPE_{ISCED0-2}$	-0.007	-0.053	-0.018	-0.041	-0.050	-0.026	-0.035	-0.063	-0.075	-0.062	-0.131
b) $MPE_{ISCED5-6}$-$MPE_{ISCED0-2}$	-0.019	-0.090	-0.036	-0.075	-0.066	-0.026	-0.049	-0.083	-0.081	-0.078	-0.144
c) $MPE_{ISCED5-6}$-MPE_{ISCED3}	-0.012	-0.036	-0.018	-0.034	-0.016	0.000	-0.015	-0.019	-0.006	-0.016	-0.013
Good (4)											
MPE for ISCED 5-7	0.510	0.320	0.600	0.567	0.559	0.486	0.312	0.572	0.228	0.628	0.708
MPE for ISCED 3	0.484	0.340	0.643	0.594	0.554	0.511	0.335	0.562	0.213	0.618	0.706
MPE for ISCED 0-2	0.419	0.357	0.615	0.563	0.516	0.501	0.414	0.504	0.283	0.589	0.541
a) MPE_{ISCED3}-$MPE_{ISCED0-2}$	0.065	-0.018	0.028	0.031	0.038	0.010	-0.079	0.058	-0.071	0.029	0.164
b) $MPE_{ISCED5-6}$-$MPE_{ISCED0-2}$	0.091	-0.038	-0.015	0.003	0.043	-0.015	-0.101	0.068	-0.055	0.039	0.167
c) $MPE_{ISCED5-6}$-MPE_{ISCED3}	0.026	-0.020	-0.043	-0.027	0.005	-0.026	-0.022	0.010	0.015	0.010	0.002
Very good (5)											
MPE for ISCED 5-7	0.093	0.590	0.259	0.305	0.168	0.279	0.626	0.202	0.735	0.250	0.073
MPE for ISCED 3	0.090	0.531	0.196	0.240	0.150	0.253	0.586	0.185	0.740	0.239	0.063
MPE for ISCED 0-2	0.087	0.445	0.199	0.225	0.120	0.228	0.470	0.158	0.581	0.175	0.029
a) MPE_{ISCED3}-$MPE_{ISCED0-2}$	0.004	0.086	-0.003	0.015	0.030	0.025	0.117	0.027	0.159	0.064	0.033
b) $MPE_{ISCED5-6}$-$MPE_{ISCED0-2}$	0.006	0.145	0.060	0.081	0.048	0.050	0.156	0.044	0.154	0.075	0.043
c) $MPE_{ISCED5-6}$-MPE_{ISCED3}	0.002	0.059	0.063	0.065	0.018	0.026	0.040	0.017	-0.005	0.011	0.010

Other explanatory variables were gross hourly wage, hours of work, gender, age and year dummies.

Source: ECHP, 1994-2001; Eurostat.

Table 3

MARGINAL EFFECTS OF BINARY DEPENDENT EDUCATION VARIABLES ON HEALTH. GENERALISED RANDOM EFFECTS ORDERED *PROBIT*

	D	DK	NL	B	F	UK	IRE	I	EL	E	P
Bad and very bad (1&2)											
MPE for ISCED 5-7	0.092	0.012	0.012	0.012	0.021	0.056	0.004	0.018	0.005	0.010	0.018
MPE for ISCED 3	0.106	0.014	0.018	0.019	0.028	0.059	0.006	0.024	0.006	0.016	0.022
MPE for ISCED 0-2	0.167	0.029	0.023	0.026	0.048	0.064	0.010	0.044	0.020	0.044	0.087
a) MPE_{ISCED3}-$MPE_{ISCED0-2}$	-0.061	-0.015	-0.006	-0.007	-0.019	-0.004	-0.004	-0.020	-0.014	-0.028	-0.065
b) $MPE_{ISCED5-6}$-$MPE_{ISCED0-2}$	-0.075	-0.017	-0.012	-0.014	-0.027	-0.007	-0.006	-0.026	-0.015	-0.034	-0.069
c) $MPE_{ISCED5-6}$-MPE_{ISCED3}	-0.014	-0.002	-0.006	-0.007	-0.007	-0.003	-0.002	-0.006	-0.002	-0.006	-0.004
Fair (3)											
MPE for ISCED 5-7	0.319	0.087	0.130	0.114	0.255	0.182	0.063	0.215	0.037	0.115	0.210
MPE for ISCED 3	0.321	0.119	0.153	0.155	0.274	0.185	0.075	0.230	0.040	0.135	0.229
MPE for ISCED 0-2	0.326	0.167	0.167	0.197	0.323	0.207	0.112	0.296	0.110	0.196	0.351
a) MPE_{ISCED3}-$MPE_{ISCED0-2}$	-0.005	-0.047	-0.014	-0.042	-0.048	-0.022	-0.037	-0.066	-0.070	-0.061	-0.121
b) $MPE_{ISCED5-6}$-$MPE_{ISCED0-2}$	-0.006	-0.079	-0.036	-0.083	-0.067	-0.024	-0.049	-0.081	-0.073	-0.082	-0.141
c) $MPE_{ISCED5-6}$-MPE_{ISCED3}	-0.001	-0.032	-0.022	-0.040	-0.019	-0.002	-0.012	-0.015	-0.003	-0.021	-0.020
Good (4)											
MPE for ISCED 5-7	0.502	0.340	0.604	0.572	0.554	0.484	0.326	0.569	0.235	0.625	0.705
MPE for ISCED 3	0.478	0.342	0.632	0.578	0.545	0.504	0.341	0.558	0.220	0.614	0.686
MPE for ISCED 0-2	0.413	0.354	0.605	0.553	0.507	0.500	0.408	0.494	0.284	0.583	0.528
a) MPE_{ISCED3}-$MPE_{ISCED0-2}$	0.065	-0.012	0.027	0.025	0.038	0.003	-0.067	0.064	-0.064	0.031	0.158
b) $MPE_{ISCED5-6}$-$MPE_{ISCED0-2}$	0.089	-0.014	-0.001	0.019	0.046	-0.017	-0.082	0.075	-0.050	0.042	0.177
c) $MPE_{ISCED5-6}$-MPE_{ISCED3}	0.023	-0.002	-0.028	-0.006	0.008	-0.020	-0.016	0.011	0.014	0.011	0.019
Very good (5)											
MPE for ISCED 5-7	0.087	0.561	0.254	0.302	0.170	0.277	0.608	0.198	0.723	0.251	0.067
MPE for ISCED 3	0.094	0.525	0.198	0.248	0.153	0.252	0.577	0.188	0.733	0.235	0.063
MPE for ISCED 0-2	0.094	0.451	0.205	0.225	0.123	0.229	0.470	0.166	0.586	0.176	0.035
a) MPE_{ISCED3}-$MPE_{ISCED0-2}$	0.000	0.074	-0.007	0.024	0.030	0.023	0.107	0.022	0.148	0.058	0.028
b) $MPE_{ISCED5-6}$-$MPE_{ISCED0-2}$	-0.008	0.110	0.049	0.077	0.048	0.048	0.138	0.032	0.138	0.074	0.033
c) $MPE_{ISCED5-6}$-MPE_{ISCED3}	-0.008	0.036	0.056	0.053	0.018	0.025	0.030	0.010	-0.010	0.016	0.004

Other explanatory variables were gross hourly wage, hours of work, gender, age and year dummies.

Source: ECHP, 1994-2001; Eurostat.

Tables 2 and 3 offer very similar results, so that we will proceed to comment them simultaneously. The interpretation of marginal probability effects p_{ei} is the average probability of being in category "i" of the health variable of individuals with level of education "e". For instance, Table 3 shows that in Germany, the probability of reporting a bad or very bad health status amongst tertiary education graduates is 0.092 (9.2 per cent), whereas the probability of reporting a good health status for the same group is 0.502 (50 per cent). We have computed as well the contribution to the probability of upper secondary (ISCED-3) versus less than upper secondary (ISCED 0-2) and tertiary (ISCED 5-7). Finally, in order to detect decreasing marginal returns to education we report as well the difference in the probability of being in the four states of health between those interviewees with tertiary versus secondary. For example, we may interpret in Table 3 that an upper secondary education graduate is 0.061 (6.1 percentage points) (row *a*) less likely to report being in a bad/very bad health status that somebody with less than that education. Accordingly, in Germany tertiary university graduates are 0.075 (percentage points) less likely to report a bad health status than those with less than upper secondary (row *b*), As a result, tertiary education graduates are 0.014 (1.4 percentage points) more likely than upper education graduates of reporting a bad or very bad health status (row *c*).

The probabilities of being in different health statuses vary considerably across countries: the most frequent answer is "good" in all countries except in Denmark, Ireland and Greece, where more than 50% of respondents report been in a "very good" health status. At the same time, "very good" is extraordinarily infrequent in Denmark and Portugal compared to other countries. It is difficult to rank countries according to the estimated health probabilities, but a ranking would have Greece, Ireland and Denmark in the top three places, and Germany and Portugal amongst the ones at the bottom.

Our aim was not to compute health probabilities themselves but differences in health across education attainment levels. The first general remarkable trend is that education contributes to reduce the probability of reporting both bad or very bad (values 1 and 2) and fair (value 3) states of health. The intensity of the reduction varies across countries. If we look at the reduction of the risk of feeling bad or very bad, it is strongest in Germany and Portugal, and mildest in Ireland and UK. If we instead focus on the reduction of the risk of feeling just in a "fair" health status, we see the highest reaction to education in Portugal. Something we can appreciate in almost all cases is that education attainment registers diminishing returns in its ability to reduce health problems: in all countries the reduction in the probability to reduce poor health status is stronger for tertiary education graduates than for upper secondary education graduates, but the relative decrease in the risk is stronger from lower secondary and less to upper secondary

that from upper secondary to tertiary. Something similar, but in the opposite direction, may be appreciated in the best health outcomes, as we will see later.

The trend as regards the influence on feeling just "good" (value 4) is a bit more blurred: here we may distinguish between three types of countries: those where both upper secondary (row *a*) and those where tertiary education (row *b*) contribute to increase the probability of reporting a good health status (Germany, Belgium, France, Italy, Spain and Portugal), tertiary education (row *b*) contributes to reduce the probability of reporting a good health status (Denmark, Ireland and Greece) and those where secondary education (row *a*) increases the probability of feeling "good" but tertiary education decreases and, instead, drives interviewees to feeling "very good" (The Netherlands and UK). For example, in Table 3, in Germany upper secondary contributes 6.5 percentage points to increase the likelihood of feeling well versus lower secondary and less (row *a*), tertiary also contributes positively to this likelihood, with a 8.9 percentage points increase (row *b*). But the trend is different in the Denmark, where any of the levels of education hardly differ in the likelihood of feeling well (1.2 and 1.4 percentage points respectively compared to lower secondary) since they have a stronger influence on the likelihood of feeling very well.

Finally, in all countries except the Netherlands and Germany secondary education contributes to increase the probability to feel in a "very good" health status. And in all countries except in Germany tertiary education contributes to increase the probability of reporting a "very good" health status.

The abovementioned diminishing returns effect is present in almost all countries in the case of the contribution of education reporting good health statuses. In most cases, tertiary education contributes to increase the likelihood of feeling ·very well more than secondary education, but the increase in this probability is lower when comparing tertiary and upper secondary than upper secondary compared to lower secondary (at most). For instance, in Table 3 it may be seen that in Denmark upper secondary education increases in 7.4 percentage points the probability of reporting very good health compared to lower levels. At the same time, the increase due to tertiary education is even stronger, 11 percentage points. But the increase between upper secondary and tertiary only means 3.6 percentage points. A similar trend may be seen in France, Ireland, Italy, Greece, Spain and Portugal. In some other cases the impact of tertiary education is so strong that returns to tertiary education compared to upper secondary are even higher than returns to upper secondary compared to lower secondary: Belgium, UK and, in a different way, The Netherlands. This result is consistent with our human capital theoretical framework: being education an input or an efficiency factor in the health production function, as in any other human capital approach, further investments may contribute to higher returns, but at a decreasing rate.

Table A1 in the appendix reports the coefficients of all the variables in the models except year dummy variables. As mentioned in Section 4 generalised ordered *probits* report three equations: the first is similar to a *probit* model where the dependent variable is 0 if the individual feels bad or very bad and 1 if the health status is above that. The second equation is similar to a *probit* model where dependent variable takes values 1 is health status is good or very good and 0 below that. The final equation is similar to a *probit* model where the dependent variable takes value 1 for "very good" health status and 0 otherwise. A positive coefficient will always be linked to higher levels of health, but interpretation is less intuitive than marginal effects and probabilities, so we will only comment the signs of the coefficients.

Table A1 shows that wages are always positively related, in one equation or another, to higher levels of health. The impact of weekly hours is quite blurred and changes across countries and equations. As for gender, women register lower health status (see results for eq 3) in all countries except in Denmark. As expected, age always contributes to reduce health. Age has been included here as a proxy for the depreciation of the stock of human capital. And finally, unlike our expectations, living alone does hardly ever contribute to explain health levels, although this is not that surprising taking into account that our sample consist on working-age population. Should we include elderly citizens in our sample, this variable would probably have had a more relevant role in the determination of health.

6. CONCLUSIONS

The analysis performed in this paper has shown that the impact of education on health is positive even when we control for other inputs in the production function and take unobserved heterogeneity into account, and it remains positive in all countries. This result contributes to understand education as a very important input and efficiency factor in the health production function. The fact that we also observe diminishing returns in the reduction of poor health risks and increase of very good health statuses also contributes to our understanding of the nature of education and health as both human capital and health as a self-provided good, as Grossman's human capital approach postulates.

This result emphasises the fact that investment in health care is not the only way to invest on future health, since the determinants of health are not only related to the health system. Inasmuch health in developed countries is determined by lifestyles and healthy habits, healthcare systems are not the only responsible for health in developed countries. Citizens may influence their health status via the occupational choices and lifestyles they adopt, and higher

qualified individuals are proved to be persistently better in the production of health. That means that more and more responsibilities will correspond to the education system in pursue of more welfare since, as our results show, education and health are very closely linked to each other[20].

We have as well contributed to the literature in showing how diverse European countries are regarding the impact of education on health. This means that policies meant to increase health are not necessarily to be similar in all these countries, since health production patterns is quite nation-specific. Therefore national specificities need to be taken into account when designing education and health fostering policies.

Finally, we have contributed to this strand of the literature from a methodological point of view. Taking advantage of the longitudinal nature of our data-set we have been able to compute changes of health as a result of changes in education and other common inputs beyond the traditional strategy that does not take into account the violation of the parallel regression assumption, namely, a generalised (random effects) *probit* model. This technique has enabled the perception of many nuances and particularities that the traditional approach (namely, the standard ordered *probit* or logit model) cannot appreciate.

We may conclude as well that more research needs to be done in order to disentangle which is the channel or channels that explain the persistent positive link between education and health. Once income is controlled for, there are several other candidates, such as use of health care and medicines, and healthy habits. In order to do so in a future, an additional data-set could be explored: the European Social Survey (ESS)[21]. The second round has a rotating module which deals which is titled "Opinions on Health and Care Seeking". It is a 30-item module by Sjoerd Kooiker[22]. This data-base guarantees homogeneity across countries and along time, which it is a basic premise to test the results of this piece of work. The scientific rigour of the project explains who in 2005 it was awarded Europe's top annual science award, the Descartes prize.

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[20] We must neither forget the relevance of infrastructure and other systems, such as the transportation system, since many deaths in the developed countries are due to traffic fatal accidents.

[21] The ESS is an academically-driven cross-sectional social survey and it is now in its third round. The survey covers over 20 nations and it is funded by the European Commission, the European Science Foundation and national funding bodies in each country. At each round of the survey, core questionnaires are completed with two or more rotating modules. More information about the survey may be found at www.europeansocialsurvey.net.

[22] It addresses the following topics: (a) Concepts of health and illness: What does (good) health mean to people? When is a symptom considered as illness? What kind of symptoms requires medical attention? (b) Seeking of ambulatory health care and taking medicines, attitudes towards treatment, perception of the doctor-patient relationship.

APPENDIX A. TABLES

Table A1

RANDOM EFFECTS GENERALISED ORDERED PROBIT. DEPENDENT VARIABLE: HEALTH STATUS (2 TO 5)
COEFFICIENTS CORRESPONDING TO EQUATION 1 (BAD AND VERY BAD AGAINST FAIR, GOOD OR VERY GOOD)

	D	DK	NL	B	F	UK	IRE	I	EL	E	P
Gross hourly wage (in logs)	0.084**	0.263**	0.035	0.223*	0.353***	0.204***	0.389***	0.404***	0.382***	0.409***	0.329***
	(2.912)	(2.673)	(0.712)	(2.094)	(7.909)	(5.385)	(3.909)	(6.947)	(4.456)	(9.339)	(9.191)
Weekly hours (in logs)	-0.118**	0.108	0.025	-0.069	0.092	-0.197***	-0.298	-0.183*	-0.027	-0.279***	0.157**
	(-3.101)	(0.741)	(0.366)	(-0.507)	(1.338)	(-3.593)	(-1.828)	(-2.306)	(-0.228)	(-4.679)	(2.770)
Tertiary edu. (ISCED 5-7)	0.477***	0.404***	0.365***	0.344**	0.221***	0.094*	0.153	0.332***	0.359**	0.406***	0.628***
	(9.612)	(3.851)	(4.365)	(2.993)	(3.302)	(2.143)	(0.943)	(3.957)	(2.927)	(6.284)	(6.064)
Secondary edu. (ISCED 3)	0.303***	0.378***	0.141*	0.128	0.193***	0.020	0.112	0.162***	0.208*	0.247***	0.475***
	(7.615)	(3.973)	(2.220)	(1.273)	(3.606)	(0.354)	(0.979)	(3.465)	(2.072)	(4.070)	(5.665)
Female	-0.201***	-0.069	-0.199**	-0.065	0.071	-0.175***	0.214	-0.077	0.021	-0.105*	-0.157**
	(-5.405)	(-0.817)	(-3.244)	(-0.657)	(1.463)	(-3.735)	(1.819)	(-1.613)	(0.231)	(-2.220)	(-3.235)
30-34 years old	-0.232***	-0.044	0.030	-0.398*	-0.166*	-0.079	-0.150	-0.102	-0.007	-0.400***	-0.396***
	(-4.788)	(-0.288)	(0.312)	(-2.397)	(-2.089)	(-1.406)	(-0.827)	(-1.278)	(-0.039)	(-4.496)	(-4.896)
35-39 years old	-0.369***	-0.106	-0.122	-0.466**	-0.252**	-0.056	-0.171	-0.226**	-0.169	-0.559***	-0.503***
	(-7.167)	(-0.703)	(-1.310)	(-2.799)	(-3.152)	(-0.915)	(-0.904)	(-2.800)	(-1.016)	(-6.281)	(-6.032)
40-44 years old	-0.432***	-0.193	-0.077	-0.445*	-0.246**	-0.027	-0.196	-0.442***	-0.204	-0.668***	-0.718***
	(-8.036)	(-1.296)	(-0.817)	(-2.572)	(-3.039)	(-0.411)	(-1.042)	(-5.579)	(-1.186)	(-7.418)	(-8.778)
45-49 years old	-0.742***	-0.217	-0.209*	-0.668***	-0.485***	-0.071	-0.307	-0.592***	-0.596***	-0.873***	-0.999***
	(-13.607)	(-1.445)	(-2.191)	(-3.776)	(-6.199)	(-1.057)	(-1.600)	(-7.551)	(-3.761)	(-9.723)	(-12.247)
50-54 years old	-0.896***	-0.542***	-0.218*	-0.442*	-0.470***	-0.085	-0.564**	-0.958***	-0.858***	-1.053***	-1.323***
	(-15.975)	(-3.755)	(-2.111)	(-2.282)	(-5.688)	(-1.228)	(-3.058)	(-12.190)	(-5.694)	(-11.576)	(-15.893)
55-59 years old	-1.247***	-0.663***	-0.243*	-0.589**	-0.597***	-0.042	-0.329	-1.127***	-1.112***	-1.262***	-1.713***
	(-21.457)	(-4.433)	(-2.054)	(-2.620)	(-6.381)	(-0.508)	(-1.516)	(-13.039)	(-7.024)	(-13.320)	(-20.090)
60-64 years old	-1.178***	-0.029	-0.412*	-0.765*	-0.874***	-0.040	-0.090	-1.188***	-1.312***	-1.444***	-1.780***
	(-14.798)	(-0.111)	(-2.464)	(-2.167)	(-5.362)	(-0.348)	(-0.293)	(-10.660)	(-6.694)	(-13.830)	(-18.900)
Living alone	-0.059	-0.209*	0.018	-0.150	-0.081	-0.045	0.108	-0.194*	-0.055	-0.115	-0.044
	(-1.205)	(-2.107)	(0.226)	(-1.092)	(-1.215)	(-0.716)	(0.393)	(-2.203)	(-0.300)	(-1.164)	(-0.411)
Intercept	1.921***	0.986	2.797***	2.162***	-0.078	1.846***	1.859***	0.623	0.527	1.067***	0.341
	(11.392)	(1.833)	(10.333)	(3.573)	(-0.252)	(8.647)	(3.541)	(1.611)	(1.049)	(4.322)	(1.403)

Wave dummies were also included but not reported for space reasons. Absolute value of t statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%; Source: ECHP (1994-2001) Eurostat.

Table A1 (cont.)

RANDOM EFFECTS GENERALISED ORDERED PROBIT. DEPENDENT VARIABLE: HEALTH STATUS (2 TO 5)
COEFFICIENTS CORRESPONDING TO EQUATION 2 (BAD, VERY BAD OR FAIR AGAINST GOOD OR VERY GOOD)

	D	DK	NL	B	F	UK	IRE	I	EL	E	P
Gross hourly wage (in logs)	0.170***	0.481***	0.093***	0.257***	0.176***	0.196***	0.327***	0.184***	0.293***	0.266***	0.289***
	(7.367)	(9.018)	(3.608)	(4.649)	(6.385)	(7.128)	(7.071)	(5.369)	(5.823)	(10.091)	(10.100)
Weekly hours (in logs)	-0.163***	-0.185*	0.036	-0.074	-0.016	-0.127**	-0.077	-0.072	0.054	-0.142***	-0.028
	(-5.386)	(-2.435)	(0.993)	(-0.992)	(-0.367)	(-3.258)	(-1.163)	(-1.601)	(0.831)	(-3.868)	(-0.592)
Tertiary edu. (ISCED 5-7)	0.231***	0.426***	0.259***	0.417***	0.158***	0.147***	0.138	0.377***	0.500***	0.257***	0.555***
	(5.460)	(6.912)	(5.217)	(6.401)	(3.692)	(4.499)	(1.882)	(8.070)	(7.792)	(7.599)	(9.047)
Secondary edu. (ISCED 3)	0.100**	0.240***	0.089*	0.166**	0.127***	0.070	0.115*	0.203***	0.359***	0.148***	0.350***
	(2.877)	(4.349)	(2.226)	(3.087)	(3.496)	(1.830)	(2.150)	(7.356)	(6.493)	(4.512)	(7.569)
Female	-0.102**	-0.024	-0.179***	-0.207***	-0.117***	-0.083*	0.132*	-0.175***	-0.178***	-0.065*	-0.309***
	(-3.188)	(-0.454)	(-4.703)	(-3.417)	(-3.720)	(-2.212)	(2.312)	(-5.727)	(-3.488)	(-2.196)	(-8.326)
30-34 years old	-0.258***	-0.222**	-0.081	-0.091	-0.191***	0.004	-0.154*	-0.293***	-0.169*	-0.224***	-0.302***
	(-7.978)	(-2.973)	(-1.759)	(-1.283)	(-5.057)	(0.099)	(-2.012)	(-8.150)	(-1.980)	(-5.808)	(-7.280)
35-39 years old	-0.503***	-0.462***	-0.343***	-0.320***	-0.413***	-0.039	-0.284***	-0.533***	-0.371***	-0.436***	-0.578***
	(-13.654)	(-5.999)	(-7.073)	(-4.328)	(-10.068)	(-0.898)	(-3.554)	(-13.541)	(-4.355)	(-10.628)	(-12.672)
40-44 years old	-0.789***	-0.573***	-0.452***	-0.383***	-0.552***	-0.057	-0.400***	-0.700***	-0.644***	-0.584***	-0.795***
	(-19.785)	(-7.228)	(-9.033)	(-4.836)	(-13.043)	(-1.231)	(-4.914)	(-16.982)	(-7.637)	(-13.756)	(-16.661)
45-49 years old	-1.020***	-0.739***	-0.530***	-0.712***	-0.669***	-0.152**	-0.467***	-0.903***	-0.936***	-0.780***	-1.223***
	(-24.342)	(-9.143)	(-10.108)	(-8.501)	(-15.435)	(-3.130)	(-5.529)	(-21.361)	(-11.097)	(-17.636)	(-24.482)
50-54 years old	-1.291***	-0.907***	-0.704***	-0.771***	-0.875***	-0.208***	-0.766***	-1.152***	-1.184***	-1.005***	-1.443***
	(-29.117)	(-11.089)	(-12.631)	(-8.366)	(-18.788)	(-4.072)	(-8.961)	(-25.291)	(-13.830)	(-21.475)	(-26.681)
55-59 years old	-1.623***	-1.061***	-0.867***	-0.954***	-1.050***	-0.212***	-0.732***	-1.249***	-1.464***	-1.258***	-1.742***
	(-33.596)	(-12.045)	(-13.467)	(-8.537)	(-18.725)	(-3.561)	(-7.567)	(-23.343)	(-15.562)	(-24.095)	(-28.900)
60-64 years old	-1.664***	-0.980***	-1.015***	-0.986***	-1.142***	-0.228**	-0.933***	-1.565***	-1.532***	-1.332***	-2.021***
	(-24.865)	(-8.303)	(-10.396)	(-5.566)	(-10.439)	(-2.781)	(-8.004)	(-21.177)	(-12.116)	(-20.670)	(-28.099)
Living alone	0.034	-0.018	-0.125**	-0.197**	-0.013	-0.001	0.007	-0.099	-0.170	-0.149*	0.040
	(0.872)	(-0.299)	(-2.831)	(-2.584)	(-0.325)	(-0.014)	(0.065)	(-1.823)	(-1.673)	(-2.574)	(0.467)
Intercept	0.254	-0.694*	1.027***	0.179	0.107	0.359*	0.156	0.094	-0.127	0.105	-0.236
	(1.861)	(-2.272)	(6.953)	(0.535)	(0.528)	(2.254)	(0.613)	(0.404)	(-0.416)	(0.676)	(-1.113)

Wave dummies were also included but not reported for space reasons. Absolute value of t statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%; Source: ECHP (1994-2001) Eurostat.

Table A1 (cont.)

RANDOM EFFECTS GENERALISED ORDERED PROBIT. DEPENDENT VARIABLE: HEALTH STATUS (2 TO 5)
COEFFICIENTS CORRESPONDING TO EQUATION 3 (BAD, VERY BAD, FAIR OR GOOD VERSUS VERY GOOD)

	D	DK	NL	B	F	UK	IRE	I	EL	E	P
Gross hourly wage (in logs)	0.095**	0.232***	0.046	0.008	0.073*	0.162***	0.277***	0.030	0.199***	0.097***	0.171***
	(3.092)	(4.940)	(1.822)	(0.153)	(2.336)	(5.843)	(7.883)	(0.807)	(5.126)	(3.812)	(3.488)
Weekly hours (in logs)	-0.030	-0.074	0.048	0.103	0.032	-0.036	-0.037	-0.041	0.003	-0.081*	0.092
	(-0.708)	(-1.179)	(1.301)	(1.495)	(0.630)	(-0.883)	(-0.726)	(-0.820)	(0.060)	(-2.252)	(1.001)
Tertiary edu. (ISCED 5-7)	-0.106*	0.308***	0.249***	0.287***	0.169***	0.142***	0.189***	0.220***	0.241***	0.172***	0.393***
	(-2.016)	(5.887)	(5.261)	(4.713)	(3.585)	(4.309)	(3.427)	(4.581)	(5.235)	(5.561)	(4.679)
Secondary edu. (ISCED 3)	-0.133**	0.212***	-0.055	0.040	0.072	0.030	0.169***	0.035	0.190***	0.108***	0.249***
	(-3.071)	(4.380)	(-1.417)	(0.770)	(1.776)	(0.765)	(4.107)	(1.171)	(4.717)	(3.582)	(3.855)
Female	-0.101**	-0.012	-0.169***	-0.237***	-0.196***	-0.109**	0.180***	-0.287***	-0.181***	-0.055*	-0.379***
	(-2.652)	(-0.263)	(-4.564)	(-4.210)	(-5.657)	(-2.915)	(3.931)	(-8.897)	(-4.605)	(-1.983)	(-6.934)
30-34 years old	-0.296***	-0.123*	-0.169***	-0.191***	-0.190***	0.035	-0.230***	-0.257***	-0.248***	-0.177***	-0.140*
	(-8.031)	(-2.403)	(-4.604)	(-3.563)	(-5.003)	(0.937)	(-4.675)	(-7.795)	(-5.070)	(-5.831)	(-2.477)
35-39 years old	-0.528***	-0.320***	-0.357***	-0.399***	-0.373***	-0.096*	-0.354***	-0.588***	-0.526***	-0.337***	-0.343***
	(-12.116)	(-5.627)	(-8.537)	(-6.598)	(-8.728)	(-2.279)	(-6.401)	(-15.267)	(-9.969)	(-9.700)	(-5.190)
40-44 years old	-0.868***	-0.508***	-0.502***	-0.574***	-0.535***	-0.101*	-0.479***	-0.820***	-0.850***	-0.527***	-0.560***
	(-17.556)	(-8.455)	(-11.337)	(-8.522)	(-11.931)	(-2.237)	(-8.238)	(-19.427)	(-15.501)	(-13.957)	(-7.581)
45-49 years old	-1.118***	-0.633***	-0.651***	-0.771***	-0.720***	-0.203***	-0.630***	-0.890***	-1.039***	-0.639***	-0.702***
	(-20.430)	(-10.167)	(-13.718)	(-10.421)	(-15.161)	(-4.236)	(-10.363)	(-20.181)	(-18.129)	(-15.530)	(-8.615)
50-54 years old	-1.299***	-0.660***	-0.802***	-0.882***	-0.923***	-0.294***	-0.738***	-1.164***	-1.292***	-0.827***	-1.117***
	(-21.645)	(-10.122)	(-15.092)	(-10.553)	(-16.897)	(-5.678)	(-11.329)	(-22.865)	(-20.973)	(-17.709)	(-10.578)
55-59 years old	-1.652***	-0.941***	-0.872***	-1.159***	-1.066***	-0.302***	-0.953***	-1.303***	-1.576***	-1.016***	-0.996***
	(-22.818)	(-12.769)	(-13.514)	(-10.632)	(-14.684)	(-4.959)	(-12.573)	(-19.969)	(-21.669)	(-17.674)	(-8.649)
60-64 years old	-1.681***	-0.870***	-0.902***	-0.954***	-0.939***	-0.352***	-1.065***	-1.662***	-1.696***	-0.988***	-1.484***
	(-15.001)	(-8.707)	(-8.448)	(-5.640)	(-6.372)	(-4.151)	(-11.008)	(-15.110)	(-15.789)	(-13.342)	(-8.412)
Living alone	0.114*	0.054	0.137**	0.030	0.080	0.021	-0.152	0.026	0.020	0.062	0.078
	(2.366)	(1.088)	(3.270)	(0.417)	(1.791)	(0.461)	(-1.741)	(0.449)	(0.260)	(1.124)	(0.556)
Intercept	-1.699***	-0.834**	-1.128***	-0.863**	-1.285***	-1.748***	-1.365***	-0.611*	-0.504*	-1.023***	-2.978***
	(-9.180)	(-3.086)	(-7.869)	(-2.766)	(-5.550)	(-10.682)	(-6.616)	(-2.458)	(-2.021)	(-6.694)	(-7.001)
Rho constant	0.565***	0.559***	0.532***	0.605***	0.497***	0.526***	0.520***	0.477***	0.403***	0.339***	0.533***
	(102.271)	(57.677)	(78.273)	(68.781)	(72.299)	(76.684)	(47.623)	(71.063)	(33.984)	(43.450)	(68.649)
Number of observations	43355	18932	35530	17464	34154	30410	16599	36867	18251	31757	28407
Log likelihood	-41953.7	-16078.2	-29481.9	-14408.6	-31798.2	-30677.6	-13456.2	-34794.8	-12918.5	-29425	-22276.6
LL test for pooled versus r.e.	13897.5	4681.76	8423	5719.11	7620.49	8393.59	3031.21	7780.06	1873.38	3064.94	6436.24

Wave dummies were also included but not reported for space reasons. Absolute value of t statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%; Source: ECHP (1994-2001) Eurostat.

APPENDIX B. THE EUROPEAN COMMUNITY HOUSEHOLD PANEL(ECHP)

a) Health related variables in the ECHP

The ECHP questionnaire is provided with 22 health related questions. Table B1 displays a description of the homogeneity issues as regards these questions in the different national questionnaires. Some of them are not asked in all countries, or are made using different methodologies, some of them are not available in all the waves. This makes it impossible to use the 22 questions in a comparative analysis with all the countries in the survey (EU-15) and to take advantage of the longitudinal nature of the data-set.

Table B1

HEALTH RELATED VARIABLES IN THE ECHP.
HOMOGENEITY PROBLEMS ACROSS COUNTRIES AND WAVES

Name	Label	a	b	c	d	e	f	g	h	i
Ph001	Health in general	X								X
Ph002	Chronic problem/illness	X	X							
Ph003	Hampered (those with chronic illness only)	X	X							
Ph003a	Hampered (question for everybody)	X	X	X						
Ph004	Had to cut down things because of illness or injury			X						
Ph005	Had to cut down things because of emotional/ mental			X	X				X	
Ph006	Admitted to a hospital as an in-patient during the last 12 months								X	X
Ph007	Number of nights spent in hospital				X1					
Ph008	Visits to a general practitioner		X	X	X					
Ph009	Visits to a specialist	X	X	X	X					
Ph010	Visits to a dentist	X	X	X	X					
Ph011	Visits to a doctor/dentist/optician	X		X	X					
Ph012	Entitled to free medical treatment under a state financed health care System?		X			X		X		
Ph013	Also covered by a private medical insurance?	X			X	X		X		
Ph014	How is the private insurance paid for?	X		X	X			X		
Ph015	How much do you pay per month for this private medical insurance?	X		X	X			X		
Ph016	Do you smoke or did you ever smoke?						X			
Ph017	No of cigarettes per day						X			

(*Keep.*)

(*Continuation*.)

Name	Label	a	b	c	d	e	f	g	h	i
Ph018	No of cigars per day						X			
Ph019	No of pipes per day						X			
Ph020	Height without shoes	X		X	X		X		X	
Ph021	Weight without clothes and shoes	X		X	X		X		X	
Ph022	Body max index	X		X	X		X		X	

a Either it is not asked in France or it is asked in a special way in France.
b It is not asked in the first interview.
c It is not asked in the GSOEP questionnaire.
d It is not asked in the BHPS questionnaire.
e The question differs across countries.
f The question is not asked during the first four waves.
g The question is not asked in the last four waves.
h It is not asked in Sweden or other countries.
i It is not asked in Luxembourg.

Despite this, ECHP offers interesting possibilities of comparisons across countries if particular care is taken in the selection of variables, countries and waves to be analysed. Under these constraints we may follow two different strategies: we may do without many variables in order to have as many countries and waves as possible, or we may do without countries and waves in order to gather information from as many variables as possible. We have adopted the former and leave the latter for future research.

b) Other relevant variables in the analysis: education attainment

The standard ECHP questionnaire was not launched eight times in all the countries surveyed under the study. Austria joined the survey in 1995, Finland did it in 1996 and finally, Sweden, in 1997. Moreover, Germany, United Kingdom and Luxembourg left the ECHP core questionnaire aside and harmonised their national panels with the ECHP. This implies homogeneity problems with these countries but at least it is possible to include them in the analysis. Sweden did not use the harmonised questionnaire in a panel structure either, and Swedish data are not a proper panel but a harmonised version of the national statistics, based on cross/section surveys and registers. Our main concern, given the very strict selection of explanatory variables in our models, is with education attainment indicators and wages.

The highest educational attainment (pt022) takes three possible values: 1 for those with the highest level (ISCED 5 to 7), 2 for those with upper secondary

education (ISCED 3) and 3 for those who have only lower secondary education or less (ISCED 0 to 2). Some individuals register "-8" and "-9" values in this variable. -9 refers to those who, for some reason, do not give any information about their education attainment, whereas -8 was used up to wave 4 for those who were still attending school. Less than 3% of those 25-64 year-old interviewees failed to answer to education attainment issues across all countries and waves. As for those registering "-8", they hardly represent 1% of the sample in every country except Belgium (up to 8%) and Italy (up to 4%).

Several anomalies have been registered in the Netherlands and France as regards these variables. In the Netherlands, from the 5th wave onwards, there is a transfer of interviewees from the highest and intermediate levels of education into the lower level of education. This is due to a recodification of qualifications during the observation window. In France, from the sixth wave onwards we register a transfer from the lowest level to the intermediate one. In these two countries we have adopted the level of education reported by the interviewee in the first interview and we have checked that this confirms the education attainment levels published by the OECD.

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SÍNTESIS

PRINCIPALES IMPLICACIONES DE POLÍTICA ECONÓMICA

En este artículo se explora la relación entre educación y salud para once países de la Unión Europea. Se estima para cada país una función de producción de salud siguiendo la teoría del capital humano de Grossman en la que la educación es uno de los *inputs* más relevantes. Para ello se consideran las ocho olas del Panel de Hogares de la Unión Europea (1994-2001). El indicador de salud utilizado es un indicador de autovaloración de salud que toma cinco posibles valores. La estrategia empírica seguida es la de los modelos *probit* ordenados generalizados con efectos aleatorios.

El resultado más relevante del trabajo es que en todos los países estudiados la educación tiene un efecto positivo sobre la salud, incluso en presencia de otros *inputs* importantes, como la renta, y teniendo en cuenta la heterogeneidad inobservada. Es bien conocido que los individuos pueden influir en su estado de salud a través de sus decisiones sobre el tipo de ocupación laboral, los estilos de vida que adoptan o sus hábitos saludables en general; en este artículo se ha puesto de manifiesto que los individuos más cualificados declaran tener un mejor estado de salud. Por tanto, podemos concluir que la educación, bien a través de su influencia sobre decisiones relacionadas con el mundo laboral o los hábitos saludables en general; o bien a través de su efecto sobre la productividad en el proceso de producción de salud, mejora la salud de los individuos. Esto significa que los determinantes de la salud no están sólo relacionados con el sistema sanitario, es más, mientras la salud en los países desarrollados venga marcada por los estilos de vida y los hábitos saludables, los sistemas de cuidados sanitarios no son los únicos responsables de su salud; y en este sentido, al sistema educativo le corresponderá cada vez una mayor responsabilidad en la búsqueda de bienestar, ya que, tal y como demuestran nuestros resultados, la educación y la salud están íntimamente relacionadas.

También observamos rendimientos decrecientes en la reducción del riesgo de mala salud y en las mejoras de salud debidas a la inversión en educación. Este resultado contribuye a que entendamos la naturaleza tanto de la salud como de la educación como formas de capital humano, y a la salud como un bien que los individuos, en parte, se proporcionan a sí mismos, tal y como postula el modelo de capital humano de Grossman. Además, este resultado pone énfasis en que aun cuando la inversión en educación tiene un efecto positivo sobre la salud de los individuos, este efecto pierde intensidad a partir de los estudios secundarios, lo cual sitúa a la educación secundaria como un objetivo de interés que puede tener efectos no monetarios sobre la salud percibida de los individuos.

Por último, apuntar que con este trabajo se contribuye a la literatura sobre la relación entre salud y educación, al mostrar lo diversos que son los países europeos con relación al impacto de la educación sobre la salud. Esto significa que las políticas dirigidas a mejorar la salud no han de ser necesariamente las mismas en todos estos países,

ya que la función de producción de salud tiene especificidades nacionales, las cuales deberían tener en cuenta a la hora de diseñar medidas de fomento de la educación y la salud.

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5. Los epígrafes irán numerados secuencialmente siguiendo la numeración arábiga. Las notas al texto irán numeradas correlativamente y aparecerán al pie de la correspondiente página. Las fórmulas matemáticas se numerarán secuencialmente ajustadas al margen derecho de las mismas. La bibliografía aparecerá al final del trabajo, bajo la inscripción "Referencias" por orden alfabético de autores y, en cada una, ajustándose al siguiente orden: autor(es), año de publicación (distinguiendo a, b, c si hay varias correspondientes al mismo autor(es) y año), título del artículo o libro, título de la revista en cursiva, número de la revista y páginas.

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Junto al original del Papel de Trabajo se entregará también un resumen de un máximo de dos folios que contenga las principales implicaciones de política económica que se deriven de la investigación realizada.

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