

POOR AND SICK: ESTIMATING THE RELATIONSHIP BETWEEN HOUSEHOLD INCOME AND HEALTH

BY ATHINA ECONOMOU

University of Thessaly

AND

IOANNIS THEODOSSIOU*

University of Aberdeen

This study evaluates the effect of the individual's household income on their health at the later stages of working life. A structural equation model is utilized in order to derive a composite and continuous index of the latent health status from qualitative health status indicators. The endogenous relationship between health status and household income status is taken into account by using IV estimators. The findings reveal a significant effect of individual household income on health before and after endogeneity is taken into account as well as a host of other factors known to influence health, including hereditary factors and the individual's locus of control. Importantly, it is also shown that the childhood socioeconomic position of the individual has long lasting effects on health as it appears to play a significant role in determining health during the later stages of working life.

1. INTRODUCTION

Research shows that decreasing socioeconomic status (SES) is associated with an increase in the risks of ill health. Evidence shows that there is a close relationship between social class and general health status and that social class is a summary measure implying differences in income, education, environment, and behavior. It also appears that cognitive functioning and mental health are positively correlated with social class, but physical health exhibits no strong relationship (Mayer and Wagner, 1993). Yet, social class is an important factor in accounting for racial and ethnic differences in health (Navarro, 1990; Smith and Kington, 1997a, 1997b). As Mackenbach *et al.* (1990) show, variation in mortality rates and health is related more to individuals' socioeconomic conditions than to the level of medical provision, to the extent that the contribution of medical care is surpassed by the impact of the factors which affect the initial incidence of diseases and infections among the population.

In view of the above there is a rising concern among policy makers that inequalities in health are widening (Wilkinson, 1986; Smith, 1999). The reason is that if poverty affects the health status, then increases in the incidence of poverty

Note: The financial support of the European Commission under the Fifth Framework Program "Quality of Life and Management of Living Resources" (contract number: QLRT-2001-02292) is gratefully acknowledged. The authors are grateful to the anonymous referees and the Editor of this journal for helpful comments.

*Correspondence to: Ioannis Theodossiou, Centre for European Labour Market Research, University of Aberdeen Business School, University of Aberdeen, Aberdeen, UK (theo@abdn.ac.uk).

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Published by Blackwell Publishing, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main St,
Malden, MA, 02148, USA.

should be expected to have detrimental effects on their health and thus on their productive capacity. This would also increase the health bill of the poorest individuals, which in turn would increase the burden on public health and welfare provision. Furthermore, the increasing inequality in health should be expected to be most visible among workers at the later stages for working life, since ageing is associated with decreasing mental, physical, and psychological capabilities (Mayer and Wagner, 1993). Hence, it is important for policy makers to identify the nature of the SES–health relationships in order to guide current and future policy.

However, the effect of SES on health is not readily assessed since reverse causality, the dynamic nature of the relationship, and its state dependence are factors which cannot be dealt with in a simple fashion. Furthermore, the multidimensional nature and the largely unobserved nature of the true health state in the usual surveys present further challenges to the researchers as they are unable to observe an overall index of the individual's latent health status.

The present study is a further attempt to evaluate the effect of SES on health using a sample of European citizens at the later stage of their working life. It attempts to identify the effect of the individual's equalized household income on the individual's health. In doing so it utilizes a structural equation model to derive a composite measure of latent health from the facets of individual health and also controls for the reverse causality in the household income–health relationship. The main findings support the existence of a strong and positive relationship between household income and health. This remains strong after the endogeneity or reverse causality is taken into account and after controlling for a host of control variables including hereditary traits and the individual's locus of control. In addition, the socioeconomic position of the respondent's household during childhood appears to also exert its own independent effect upon health.

The policy implications of this paper are important: if childhood and current low SES is reflected in low health status at the later stages of the working life, then SES would have a significant and independent effect on the productive capabilities and labor market participation of the older individuals over and above the effects that are expected to be present due to the frailty attributable to advancing age. In addition, the retirement decisions of this section of the labor force would be also affected. This would have a direct effect on the national finances of public health, health services, and social security.

The paper is organized as follows. Section 2 offers a brief literature review to provide a conceptual basis for the study, Section 3 presents the dataset and the variables employed in the study, and Section 4 presents the methodological framework. Section 5 discusses the results and Section 6 concludes.

2. A BRIEF LITERATURE REVIEW

There has been substantial progress in research into the association between individual SES and health although the research base remains inadequate. Higher SES, usually approximated by employment status, education level, and income, appears to be associated with better physical health (Ecob and Davey Smith, 1999; Grundy and Holt, 2000; Wagstaff *et al.*, 2001; Blakely *et al.*, 2002; Buckley *et al.*, 2004; Demakakos *et al.*, 2008), with improved emotional and psychological health

(Theodossiou, 1998; Everson *et al.*, 2002), and with reduced risk of mortality (Goldman *et al.*, 1995; Gardner and Oswald, 2004). Individuals of higher SES appear to enjoy a higher survival probability in comparison to the remainder (van Rossum *et al.*, 2000), and individuals in the lower steps of the socioeconomic ladder face a higher burden on ill health. A comprehensive survey of this literature appears in Johansen *et al.* (2006).

Overall, income and wealth are closely associated with occupation and social class. Income has important effects on individuals' health since it determines individuals' standards of living. Wagstaff *et al.* (2001) find that income has the greatest explanatory power in accounting for ill health, accounting for approximately 60 percent of inequality in ill health. Blaxter (1990) shows that the income–health relationship appears to be a non-linear one; as income increases health improves initially, but at the high end of the income scale, there is a small negative effect on health. Navarro (1990) further shows that there are great disparities in health in terms of both mortality and morbidity, due to disparities in wealth and income even if the effects of race are netted out. Thus, though there are differences in health status among ethnic groups in the older workers, such effects are driven by disparities in income. Van Doorslaer *et al.* (1997) find that income inequality is strongly correlated with health inequality across countries. Socioeconomic inequalities in health are found to affect in a differential fashion groups of elderly individuals who exhibit different educational, occupational, or income characteristics (Martelin, 1994). In contrast, Goldman *et al.* (1995) document a strong negative relation between advantageous economic factors and disability status although the effects appear to be lessening for the elderly (O'Reilly, 2002). This is also supported by Kiuiila and Mieszkowski (2007) who find that the relationship between mortality, income, and education becomes weaker with age.

Notwithstanding the above research, the nature of the SES–health relationship is a contested issue among researchers, since the possible reverse causality, the dynamic nature of the relationship, and its state dependence are factors which obscure the SES–health link (Hernández-Quevedo *et al.*, 2008). Indeed, one can argue that not only does income affects health, but also health limitations may negatively affect the individual's position in the income ladder as they affect their earnings capacity. In addition, economic hardship might have a long term effect upon health, or accumulated health problems might lead to a belated health status decline. Yet, Hurd and Kapteyn (2003) still finds a significant relationship between wealth and certain types of illnesses after controlling for wealth endogeneity, in line with earlier results of Smith (1999), who shows that the positive income–health relationship holds even after controlling for the endogeneity of income.

To deal with the issue of reverse causality in the SES or income–health relationship a number of empirical methodologies are applied in the literature. Indirect methods use a number of approaches such as limiting the investigation to individuals with an initially good health state (Lynch *et al.*, 1997) or disaggregating the sample to individuals with different levels of health (Fuchs, 2004) or utilising fixed-effect models (Winkelmann and Winkelmann, 1998). Alternatively, a number of studies use the instrumental variables approach (Ettner, 1996; Lindahl, 2005). Furthermore, studies investigate the relationship between SES and health in a

longitudinal setting (Buckley *et al.*, 2004; Hurd and Kapteyn, 2003; van Ourti, 2003).

Contoyannis *et al.* (2004) use a dynamic panel model in order to control for the existence of state dependence and heterogeneity in individual health status. They find that positive state dependence affects current health outcomes and that heterogeneity accounts for approximately 30 percent of the unexplained variation in health. Yet, the effect of socioeconomic inequalities in health remains important. In line with the above, Hernández-Quevedo *et al.* (2008) utilize random effects probit models to find that heterogeneity and state dependence are significant factors in explaining current health outcomes.

The literature indicates that individual health status is a multifaceted concept (Duncan *et al.*, 2002). According to the World Health Organization (WHO, 1948, p. 100) “health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” Thus, individual health status is comprised of a number of dimensions of individual health, such as physical health and psychological or emotional health state, but also facets unobserved to the researcher not possessing direct medical information. However, researchers focus on one or more of the above aspects of health state. The vast majority of studies on the SES–health link are based on investigating self reported information on various facets of health status such as functional limitations, psychological status, or self evaluation of general health. In view of the multidimensional nature and largely unobserved true health state it is difficult to construct an overall index of the latent health status. Hence, it remains a challenge for researchers to devise health measures that will facilitate a broader index of individual latent health status in the absence of accurate medical information which is not usually available in the common surveys.

The present study is a further attempt to evaluate the effect of SES on health using a sample of European citizens at the later stage of their working life. The SES is approximated by the level of the individual’s current equivalized household income and their household level during childhood. The endogenous nature of the socioeconomic position–health relationship is taken into account by the use of the instrumental variable approach. In addition, this study utilizes structural equation models to derive a composite measure of latent health from the facets of individual health (Wolfe and van der Gaag, 1981). Thus, it addresses the issue of the multidimensional nature of the latent health status by constructing a continuous composite health indicator with the use of structural equation models.

3. THE DATASET AND VARIABLES USED

This study utilizes a dataset, derived from a survey administered under the auspices the SOCIOLD (2003–06) research project funded by the European Commission. The derived dataset is a representative sample of individuals in six European Union countries, namely Denmark, Finland, France, Greece, the Netherlands, and the U.K.¹ The survey questionnaires are identical for all coun-

¹Further information on the project can be found at <http://www.abdn.ac.uk/sociold/index.hti>. The six countries correspond to the nationality of the project partners.

tries and they are translated by native bilingual researchers. The SOCIOLD (2005) targets individuals at the later stages of their working life (45 to 65 years of age). Since it is a cross-section dataset, the lack of a time series element does not permit the study of the short term dynamics of the SES–individual health relationship. However, it contains a wealth of detailed information on demographic, socioeconomic, and health status and it permits the study of the long term effects of low SES in childhood on the individual health during late adulthood as it provides the relevant information of the individual SES at childhood.

Four measures of individual health state are included in the analysis. They are derived from standardized questions often used in large scale surveys such as the European Community Household Survey and the General Health Questionnaire (GHQ). The first is the self-assessed health status (SAHS). It provides information on the overall health condition of the respondent (Groot, 2000; van Doorslaer and Jones, 2003). Studies suggest that there is a systematic variation in self-assessed health responses for different SES, age, or gender groups (Grundy and Holt, 2000; Crossley and Kennedy, 2002; Lindeboom and van Doorslaer, 2004). However, Allison and Foster (2004) argue that self-assessed health is a strong predictor of objective health measures, such as mortality. The second is the Mobility Index which is constructed as the sum of scores of the respondent's mobility limitations based on responses of the respondents to 20 questions regarding the ability of the individual to bathe or dress; walk one block; walk some blocks (2–3); walk more than a mile; bend, kneel, or stoop; climb one flight of stairs (e.g. a floor); climb several flights of stairs; lift or carry groceries; do moderate activities (lift or carry weights over 5 kg, move a table, pull or push large objects like a living room chair, push a vacuum cleaner, bowling or playing golf); and do vigorous activities (running, participating in strenuous sports, lifting heavy objects, etc.). The response options are: 0, not at all difficult; 1, a little difficult; 2, very difficult.

The third is the Emotional Health Index1, is constructed by summing up the relevant respondents' scores regarding their recent emotional health; finally, the Emotional Health Index2 is comprised of the sum of scores in questions regarding respondents' recent emotional condition. Details of the definition of the above variables are reported in Table 1 (first panel).

A number of personal and other control factors are also included in the regressions. Age, gender, marital status, and educational attainment are included.² The individual's educational attainment level is derived from identical questions across countries corresponding to the International Standard Classification of Education (ISCED) provided by UNESCO (1997).³ Genetic and inherited traits are known to affect systematically one's health but are seldom used in studies since

²Age squared was also included in the regressions to test for a non-linear effect of age on health but the effect turned out to be not statistically significant.

³The educational level categories take into account the national standards in a way that conforms to the ISCED classification. For this study the educational levels are redefined so that lower educational status correspond to levels 0–2 ISCED 1997, middle educational status to levels 3–4 ISCED 1997, and high educational status to levels 5–6 ISCED 1997. This is in line with educational categories reported in the European Community Household Survey (ECHP) and the European Labour Force Survey (ELFS) (see also del Campo *et al.*, 2006).

TABLE 1
DEFINITIONS OF VARIABLES AND MEANS

Variables	Mean	Definitions
Health Variables		
Latent Health	0.797	A index of latent objective health predicted by SEM regressions of health variables on individual health status described below
SAHS	2.776	Self-assessed health status (1: bad/very bad; 2: fair; 3: good; 4: very good)
Mobility Index	2.385	Index constructed as the sum of scores in questions regarding respondent's ability to bath or dress, walking one or more blocks, bend, kneel or stoop, climb stairs, lift or carry groceries, do moderate or vigorous activities (0: absence of mobility limitations–20: presence of all the above mentioned mobility limitations)
Emotional Health Index1	10.648	Index constructed as the sum of scores in questions regarding respondent's recent emotional condition, i.e. feeling slowed down, tense, having worrying thoughts, sudden feelings of panic, feeling cheerful, enjoy a good book or TV program, trouble with sleeping, easily bored or irritated, difficulty in concentrating, lonely (0: absence of emotional health problems–30: presence of emotional health problems)
Emotional Health Index2	8.889	Index constructed as the sum of scores in questions regarding respondent's recent emotional condition, i.e. whether the respondent is feeling that he enjoys the things that he used to enjoy, looking forward with enjoyment to things, laugh and see the funny side of things, is irritable, having lost interest in his appearance (0: presence of emotional health problems–20: absence of emotional health problems)
Income and Socioeconomic Status (SES) Variables		
Equalized Household Income	3.468	Total net household income (gross for the U.K.) from all sources for the year 2003 adjusted for PPP (income is divided by 10,000 for all countries)
High SES in Childhood	0.123	SES in childhood (1: the respondent's family was above average SES when he started school; 0: otherwise)
Average SES in Childhood	0.518	SES in childhood (1: the respondent's family was of average SES when he started school; 0: otherwise)
Low SES in Childhood	0.359	SES in childhood (1: the respondent's family was below average SES when he started in school; 0: otherwise), omitted from regressions
Education		
Higher Education	0.504	Educational Status (1: higher educational status, 0: otherwise)
Middle Education	0.286	Educational Status (1: middle educational status, 0: otherwise)
Lower Education	0.210	Educational Status (1: lower educational status, 0: otherwise), omitted from regressions
Demographic Variables		
Age	56.045	Age in years
Males	0.507	Gender (1: male; 0: otherwise)
Females	0.493	Gender (1: female; 0: otherwise), omitted from regressions
Married/Cohabiting	0.759	Marital status (1: married/cohabiting; 0: otherwise)
Divorced/Widowed	0.181	Marital status (1: separated/divorced/widowed; 0 otherwise)
Single	0.060	Marital status (1: single; 0 otherwise), omitted from regressions

TABLE 1 (continued)

Variables	Mean	Definitions
Genetic Endowments and Locus of Control Variables		
Genetic Factors Index	3.336	Index calculated as the sum of scores regarding first-degree relatives' experience of specific health problems, e.g. cardiovascular, cerebrovascular, respiratory, endocrine, musculoskeletal, gastrointestinal, genitourinary, malignant growth, benign growth, diabetes, high blood pressure (0: absence of any health problems–18: presence of all the above mentioned health problems)
Locus of Control Index	15.902	Index calculated as the sum of scores in questions regarding respondent's beliefs on specific questions drawn from Ray (1980); a larger score indicates a more "extroverted" type of personality whereas a lower score indicates a personality type more "introverted"
Country of Residence		
DK	0.224	Country of residence (1: the respondent lives in Denmark; 0: otherwise), omitted from regressions
FI	0.122	Country of residence (1: the respondent lives in France; 0: otherwise)
FR	0.170	Country of residence (1: the respondent lives in Finland; 0: otherwise)
GR	0.206	Country of residence (1: the respondent lives in Greece; 0: otherwise)
NL	0.146	Country of residence (1: the respondent lives in the Netherlands; 0: otherwise)
U.K.	0.132	Country of residence (1: the respondent lives in Great Britain; 0: otherwise)
Instruments		
Art Collection	0.160	Household (1: ever bought valuable paintings or other art collections; 0: otherwise)
Children's Education	0.265	Children's education (1: if paying for children's education or private school; 0: otherwise)
Won Lottery/Inheritance	0.289	Won in lottery/inheritance (1: anyone in the family ever won in lottery or received inheritance worth more than 14,000 euro; 0: otherwise)

there is a lack of such information in most of the surveys. The dataset used contains suitable information for the individual genetic traits; it can facilitate the construction of an index derived from information regarding a variety of hereditary health conditions suffered by the individual's first-degree relatives. Detailed definitions appear in Table 1 (fifth panel).

The question on household income in the SOCIOLD survey is similar to that in the European Community Household Panel Survey (ECHP), namely, "Which of the following income categories best describes your total 2003 household income from all sources (including unemployment, disability or other benefits, pensions, investments and dividends), after tax and other deductions?"

A range of 13 income categories, comparable among countries, is offered to the respondents. The use of income ranges is preferred as it limits non-responses and encourages respondents to provide accurate information. In the present paper the continuous measure of income is derived by taking the middle value from the income categories for each participant. The income amount is equalized based

on the household members with weights similar to those used in ECHP survey. The average household income appeared to closely trace the respective income obtained from the ECHP.

Importantly, the survey provides information on the individual's SES in childhood. Respondents are asked how well-off their family was when the respondent started school. Three response options are offered (average, below average, above average). The question is phrased deliberately in simple terms in order to convey the general sense of the SES status of the family during childhood so as to reduce the likelihood of memory bias that could plague a more detailed ranking. This information is used in order to control for family SES during childhood. Self-reported questions regarding family SES during childhood are commonly utilized in empirical research and they have been found to be strong predictors of adult health (Luo and Waite, 2005).

Locus of control is also included as a regressor in the estimated model. Locus of control is a strong indicator of an individual's personality, and therefore it is expected to affect individual choices and preferences regarding investments in health. Locus of control reveals information about individual beliefs and personality characteristics and it can be predictive of emotional behavior (Lefcourt, 1973; Ray, 1980). The survey question on locus of control is drawn from Ray (1980). He constructed a ten-item indicator. Low values in the locus of control score indicate a more "introvert" personality. Higher scores indicate individuals with relatively "extrovert" personalities. Individuals with low scores in locus of control feel that they can control their fate with their actions, in contrast to individuals with higher scores in locus of control who feel that their experiences in life are often beyond their control. Therefore, locus of control is a significant determinant of individual mental health status (Dunn, 2000) and individual preferences regarding investments in health behavior. Goldsmith *et al.* (1997) show that locus of control exerts an indirect effect, through psychological capital on individual wages. Poortinga *et al.* (2008) argue that it is a significant determinant of individual health status and moreover, that its inclusion in the regression reduces SES inequalities in health. Bosma *et al.* (1999) and Lundberg *et al.* (2007) show that locus of control indicates that beliefs of low control over life are more common among lower socioeconomic groups and they are strongly related to mortality risk; it is strongly related to individual health status.

The sample size is 3137 observations, comprising 702 individuals for Denmark, 383 individuals for Finland, 533 individuals for France, 646 individuals for Greece, 415 for the Netherlands, and 458 individuals for the U.K. In view of the relatively small number of individuals per country, the pooled sample is used for the analysis. In all regressions, individual country dummy variables are introduced to control for country fixed effects. Detailed definitions of the variables included in the models and their descriptive statistics are presented in Table 1. It is shown that approximately 50 percent of the sample are male. The mean age of the sample is 56 years of age. The mean value of self-assessed health status seems to be better than "good" (65 percent of the sample feel they are in "good" and "very good" health status). A similar result is implied by the other health status indicators used in the study (the mean value of the mobility index shows that half of the sample has very limited mobility problems and the mean values of the two

emotional indices indicate that on average individuals enjoy a good health state with limited emotional problems).

4. THE METHODOLOGICAL FRAMEWORK

The literature suggests that the individual health status is a multidimensional concept. It incorporates many health facets such as physical health status, mental health status, and psychological health status. Some of them may also be measured with error (e.g. self assessed health). Hence, the latent objective true health status of the individual is not observable by the researcher. One of the main aims of this paper is to create a continuous latent health status indicator which will incorporate the different observable dimensions of individual health but will also take into account any possible measurement errors. In doing so, the Structural Equation Model is employed which provides an estimate of the latent health status scores with the use of Systems of Measurement Models (Jöreskog, 2000). Structural Equation Model techniques have the advantage of estimating unobserved variables to the researchers. The model accommodates the latent variables in a system of equations. The basic idea is that, after the indirect and direct pathways that operate on the relationships of interest are defined, the latent variables, though they cannot be observed by the researcher, can be estimated by their relation to observed variables (multiple indicators). This method also takes into account the measurement errors on the observed variables. These models are known as measurement models (Maruyama, 1998).

In order to derive individual latent health scores, the following Structural Equation System is estimated which relates *unobserved* individual *Latent Health* status to the observed health status indicators (*SAHS*, *Mobility Index*, *Emotional Health Index1*, *Emotional Health Index2*) for each individual *i* as follows:

$$(1) \quad SAHS_i = a_{1i} Latent Health_i + \varepsilon_{1i}$$

$$(2) \quad Mobility Index_i = a_{2i} Latent Health_i + \varepsilon_{2i}$$

$$(3) \quad Emotional Health Index1_i = a_{3i} Latent Health_i + \varepsilon_{3i}$$

$$(4) \quad Emotional Health Index2_i = a_{4i} Latent Health_i + \varepsilon_{4i}$$

where ε_{1i} , ε_{2i} , ε_{3i} , ε_{4i} are the errors in measurement of the true objective *Latent Health* status as measured by the *SAHS*, *Mobility Index*, *Emotional Health Index1*, *Emotional Health Index2* health indices, respectively.

The above Structural Equation System (1)–(4) is estimated by using maximum likelihood to obtain an estimate of the individual objective *Latent Health* status.⁴

⁴Using the LISREL software. More information about the LISREL software is provided at www.ssicentral.com.

After obtaining the estimate of the objective *Latent Health* status the following model is estimated:

$$(5) \quad \text{Latent Health}_i = \beta_{1i} \text{Equivalised Household Income}_i + \beta_{2i} X'_i + u_i$$

where individual *Latent Health* status is explained by the equivalized household income (the main regressor of interest in this study), the childhood SES, the educational status, and other individual characteristics (X'_i).⁵

To deal with the issue of reverse causality the Instrumental Variables approach is utilized. Thus, the following model is estimated as the auxiliary regression:

$$(6) \quad \text{Equivalised Household Income}_i = \gamma_{1i} \text{Latent Health}_i + \gamma_{2i} X'_i + \gamma_{3i} Z'_i + v_i.$$

In equation (6) individual latent health status appears as an independent variable in the right hand side of the equation, along with the rest of the exogenous regressors (X'_i). In order to achieve identification of the system of equations (5)–(6), the identifying restrictions Z'_i are included in equation (6). The instruments Z'_i should be relevant, that is they must be jointly significantly correlated with the Equivalized Household Income. They should also be valid, that is they should not be correlated with the error term u in equation (5). Intuitively, the first condition implies that the instruments will contain sufficient information on observed Equivalized Household Income, which is not contained in the regressors vector X , while the second requirement ensures that their impact on Latent Health in equation (5) comes exclusively from their correlation with observed Equivalized Household Income. Although the above statistical properties of the identifying restrictions should be satisfied, they must also be justified by economic intuition. The three instrumental variables are:

1. Whether the respondent ever bought valuable paintings or other art collections.
2. Whether the respondent privately pays for his children's education.
3. Whether the respondent or any other household member has ever won on the lottery or inherited more than 14,000 euros.

The three instruments are expected to affect the household financial situation, since they reflect specific aspects of an individual's position in the income distribution, but there is no compelling reason to expect that they would affect the health state of the individual.

In order to statistically investigate the relevance of the above instruments the F-test of their joint significance in the first-stage regressions (equation (6)) is employed. If the chosen excluding restrictions are "weak," i.e. have little explanatory power, then the bias in the estimated instrumental variable (IV) coefficients is expected to increase (Hahn and Hausman, 2002). Stock and Yogo (2002) provide the tables of the critical values for testing the presence of weak instruments. The critical value is a function of the number of included endogenous regressors (Equivalized Household Income), the number of instrumental variables, and the

⁵A detailed explanation of the variables included in the models and their descriptive statistics are presented in Table 1.

TABLE 2
JOINT SIGNIFICANCE OF THE INSTRUMENTS AND OVER IDENTIFICATION
AND ENDOGENEITY TESTS

Weak Identification Test	
First Stage	Equivalized Household Income
Joint Significance of Instrumental Variables	17.39 (0.00)
F (3, 3133)	
Second Stage	Latent Health
Sargan Test	3.256 (0.196)
Chi-sq (2)	
Endogeneity Tests	
	Equivalized Household Income
Wu–Hausman	6.362 (0.012)
F (1, 3119)	
Durbin–Wu–Hausman	6.385 (0.012)
Chi-sq (1)	

Note: p-values are presented in brackets.

desired maximal bias of the IV estimator relative to OLS (Stock and Yogo, 2002). Table 2 presents the joint significance F-tests performed for equation (6) (first panel). The test rejects the weak instruments hypothesis if the F-statistic exceeds the critical value (13.91). Therefore, the weak instruments hypothesis is rejected.

Regarding the issue of instruments' independence from the error process, the Sargan over-identification test is used. This statistic, which equals the number of observations minus the degree of freedom, times R^2 , follows the chi-square distribution. A rejection of the null hypothesis (of correct model specification and orthogonality conditions) casts doubt on the validity of the instrumental variables, since they are either not truly exogenous or incorrectly excluded from the equation. The performed Sargan tests in Table 2 (second panel), suggests that the instruments do not jointly exert any statistically significant effect on Latent Health, since they are not correlated to the error process u .

Finally, it is important to formally establish the presence of endogeneity/reverse causality bias. Since the IV estimator always has a larger asymptotic variance than the OLS estimator, there is loss of efficiency in the former approach. Hence, the necessity of resorting to instrumental variables should be statistically assessed. Two alternative, asymptotically equivalent, tests, the Durbin–Wu–Hausman and the Wu–Hausman are employed to examine whether OLS is inconsistent and IV is required (Table 2, third panel). A rejection of the null hypothesis implies that the OLS estimator does not yield consistent estimates due to endogeneity and therefore the IV estimator should be used. The test rejects the null hypothesis ($p = 0.012$, Table 2), implying the endogeneity of the *Equivalized Household Income variable* in equation (5). This justifies the choice of the IV approach. Yet, in view of the level of significance it may be prudent to correct for endogeneity of household income, hence the corrected versions of the estimates are discussed below but the OLS estimates are also reported.

TABLE 3
LATENT HEALTH STATUS REGRESSIONS

Dep. Variables	Latent Health
Self Assessed Health	0.941**
Mobility Index	-2.074*
Emotional Health Index 1	-1.209
Emotional Health Index 2	0.584**
Chi-square	33.551
DoF	2.000
RMSEA	0.071
NFI	0.967
AGFI	0.973
Observations	3137

Note: *statistical significance at 10%, **statistical significance at 5%, ***statistical significance at 1%.

5. EMPIRICAL RESULTS

5.1. Latent Health Status and its Correlates

Table 3 reports the results of the Structural Equation Model on the relationship between the observed individual health state variables and latent health status (equations (1)–(4)).

The results are straightforward. Self-assessed health status appears to be strongly and positively related to latent health status. The mobility index is negatively and statistically significantly related to latent health. Finally, the Emotional Health Index2, where higher scores indicate the absence of emotional or psychological health problems, is related positively to higher latent health status. The Emotional Health Index1 is not found to be associated with latent health. From the estimation of the above model the individual latent health scores are derived.

5.2. The Determinants of Latent Health Status

The estimation results of the auxiliary regression (6) are reported in Table 4 (first column) for completeness. However, they are not discussed for space considerations. Table 4, second column, reports the results of OLS regressions of the individual health function.⁶ The third column reports the results of the IV regressions, which takes into account the endogenous nature of the latent health–individual household income relationship.

In the OLS estimation the effect of equalized household income turns out to be statistically significant and positively related to latent health. Importantly, even after the endogeneity/reverse causality correction, the relationship remains both positive and statistically significant. Household income is found to be a strong predictor of various dimensions of health status in the relevant literature (Peiró, 2006; Nummela *et al.*, 2007). In line with Lindahl (2005), the relationship between income and health remains significant, event after endogeneity corrections.

The literature on the effects of childhood socioeconomic conditions on adult health is rather limited. Kuh and Wadsworth (1993) argue that there are several

⁶Heteroscedasticity corrected standard errors are reported throughout.

TABLE 4
EQUIVALIZED HOUSEHOLD INCOME DETERMINANTS; FIRST STAGE ESTIMATION AND INDIVIDUAL
DETERMINANTS OF LATENT HEALTH STATS; OLS AND 2SLS

Ind. Variables	Dependant Variable		
	Equivalized Household Income	Latent Health Status	
	First Stage Estimation, Reduced Form	OLS	IV
Demographics			
Age	-0.045***	-0.009***	-0.005
Males	0.245***	0.091***	0.071**
Married/cohabiting	1.261***	0.210***	0.098
Divorced/widowed	0.247	0.151**	0.124
Genetic endowments and locus of control variables			
Genetic Factors Index	-0.008	-0.079***	-0.078***
Locus of Control Index	-0.038***	-0.024***	-0.020***
Education			
Higher education	1.029***	0.203***	0.103*
Middle education	0.588***	0.141***	0.090*
Income and SES variables			
High SES in childhood	0.047	0.117***	0.100**
Average SES in childhood	0.138	0.070**	0.066*
Equivalized household income		0.029***	0.111***
Country of residence			
FI	3.876***	0.013	-0.300**
FR	2.525***	0.143***	-0.075
GR	2.254***	-0.085**	-0.275***
NL	5.719***	-0.232***	-0.698***
U.K.	4.716***	-0.179***	-0.556***
Instruments			
Art collection	1.033***		
Children's education	0.427***		
Won lottery/inheritance	0.282***		
Constant	1.544***	1.440***	1.306***
R-squared	0.454	0.092	0.038
F-test	214.23	18.41	16.47
	(0.00)	(0.00)	(0.00)
Observations	3137	3137	3137

Note: * Statistical significance at 10%, ** statistical significance at 5%, *** statistical significance at 1%.

pathways through which childhood experiences may affect health status in adulthood. Indeed, the findings of the present study indicate that individual SES during childhood has an independent and significant effect on the health of individuals in late adulthood revealing the long term repercussions of childhood poverty. Harper *et al.* (2002) argue that childhood socioeconomic circumstances are predictive of adult health but adult SES is a stronger predictor of adult health, implying that favorable conditions in later life can offset the negative health effects of low SES during childhood. The present study shows that respondents whose families belonged to a higher SES during their childhood, experience better health in comparison to the remainder. These findings are in line with the relevant literature.

For instance, Luo and Waite (2005) utilize a similar childhood SES indicator to that in the present study to report results well-matched with the present findings. Lahelma *et al.* (2006), Rakkonen *et al.* (1997), and van de Mheen *et al.* (1998) also show that low socioeconomic position in childhood can lead to increased health problems or mortality in adulthood. In line with the literature, education level is found to have positive effects on health (Hagen *et al.*, 2006; Von dem Knesebeck *et al.*, 2006). Finally, a surprising result is that there appear to be no age effects on health. One should not expect an effect of ageing on health given the narrow age range of middle aged individuals investigated in this study.⁷

These findings highlight the deleterious effect of childhood and current low household income and household poverty on health for individuals at their later stages of their working life, even after controlling for a host of other personal characteristics including hereditary traits and psychological disposition reflected in the locus of control factor.

A robust effect of the genetic factor on health is important. Whether first-degree relatives have suffered diseases known to be of a hereditary nature is strongly associated with lower health state. Adams *et al.* (2003) show that hereditary health problems can affect individuals' health state and indirectly their capability to work and hence their productivity. Moreover, the locus of control index is found to be associated with health. Research indicates that people with low scores in locus of control tend to have more adaptive behaviors, take a more active interest in their health care, and experience more positive psychological and physical health outcomes (Oberle, 1991) compared to the remainder. This study confirms that individuals with low scores in locus of control experience better health state in comparison to the remainder. To the knowledge of the authors there are no studies on the income–health relationship that control for the above factors.

6. CONCLUSIONS

This paper investigates the SES determinants of individual health status. It introduces a method that enables the construction of an index for the individual latent health status that incorporates various observed dimensions of the individual health status, but importantly, it takes into account measurement errors in these observed health dimensions by using Structural Equation Modeling techniques. It also takes into account the reverse causality between household income and health. Although the study uses a cross section dataset which does not permit the study of the short term dynamics of the health–SES relationship, it provides some evaluation of the effect of childhood SES on health during later adulthood.

A strong and positive relationship between household income and health is observed after controlling for reverse causality and a host of other factors including hereditary factors and the individual's locus of control. The effect of personality traits and genetic factors on health has often been ignored in previous research. Importantly, there appears to be a significant independent effect of SES position in childhood on health status at the later stages of the working life.

⁷Indeed, the raw health measures and the latent health scores indicate that there is not a substantial variability of the mean health by age.

The above highlights the long term repercussions of poverty on health. There appears to be an intricate mechanism through which childhood poverty affects adult health. One should expect that SES status at childhood may affect not only an individual's health status at childhood (Dooley and Curtis, 1998), but also their physical development (Currie and Stabile, 2003), their education, and their preferences during youth regarding the intertemporal discount rates for future investments in health and education (Chapman and Elstein, 1995; Smith, 2009). These should be expected to affect, in turn, their investments in future health, their later health, and their earnings capacity throughout the life course. The above finding has important implications for policy. If childhood and current low SES is reflected in low health status at the later stages of the working life, then SES should be expected to have a significant and independent effect on the productive capabilities and labor market participation of the older individuals over and above the effects that are implied by the frailty attributable to advancing age. This has important implications for the labor market participation of the older population and early retirement decisions in an era of ageing populations in Europe. This should be expected to have a direct and deleterious effect on national budgets for public health, health services, and social security. Overall, it appears that policies aiming at improving population health may be largely facilitated by policies aiming at reducing the exposure of the young to poverty.

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