UNIVERSITÀ di VERONA | Department of ECONOMICS

Working Paper Series
Department of Economics
University of Verona

The Shared Non-cognitive Roots of Health and Socioeconomic Status: Evidence from the US

Alessandro Bucciol, Chiara Coriele, Luca Zarri

WP Number: 14 July 2020

ISSN: 2036-2919 (paper), 2036-4679 (online)

THE SHARED NON-COGNITIVE ROOTS OF HEALTH AND SOCIOECONOMIC STATUS: EVIDENCE FROM THE US

Abstract

A voluminous literature established a strong relationship between subjective health and socioeconomic status measures. We test the idea that self-reported health and subjective socioeconomic status have "shared non-cognitive roots", i.e., that *the same personality traits* significantly affect both status variables, even after controlling for the complex relationships involving objective and subjective measures across the two domains. To this aim, we estimate a bivariate model based on longitudinal large-scale data (30,675 observations) from six waves (2006-2016) of the US *Health and Retirement Study*. Our findings strongly support our conjecture, as *all* the "Big Five" traits are significantly related to self-reported health and subjective socioeconomic status with the same sign, even after controlling for both objective measures and once the other subjective measure is considered. These results point to a novel, direct channel through which non-cognitive factors similarly influence self-evaluations across distinct, though strongly intertwined, domains.

Keywords: Self-reported Health Status; Subjective Socioeconomic Status; Non-Cognitive Factors; Bivariate Model.

JEL Classification: D91; I14; I31.

1. Introduction

One of the key lessons from the global Covid-19 outbreak we are currently living through is the dramatic confirmation that health and socioeconomic status are closely intertwined. But what shapes individuals' evaluations of their own health and socioeconomic status? Addressing this question, that is, understanding the determinants of general *self-rated health* (hereafter, SHS) and *perceived socioeconomic level* (hereafter, SSS), is extremely relevant due to the importance of these well-known status measures in these two key domains.

SHS is arguably the most widely used measure of health in medical, social, and behavioral science research using survey data. It has also been shown to be a powerful predictor of mortality and is extensively employed internationally as a clinical investigation and public health surveillance tool as well as to study trends and health inequalities between and within countries – including the estimation of aversion to health inequality.[1] As to SSS, as pointed out by Bucciol et al. (2020), available evidence indicates that subjective appraisals of socioeconomic status play a key role within several economically and socially relevant domains, including labor supply, aggregate consumption, saving patterns, preferences for redistributive policies, and voting decisions (see, e.g., Cruces et al., 2013, and Sosnaud et al., 2013).

Importantly, in the last two decades, a burgeoning literature in psychology, medicine and economics established a very strong and robust relationship between these two subjective status measures.[2] This association holds across participants of varying socioeconomic backgrounds and seems to be even stronger than the link between health and objective socioeconomic status (Adler et al., 2000; Operario et al., 2004). However, despite the availability of literally dozens of empirical studies documenting this relationship between SHS and SSS, the underlying mechanisms are still, to a large extent, unclear. Though in principle this correlation might be spurious (Ostrove et al., 2000; Singh-Manoux et al., 2005), prior research suggests that it is not driven by common method bias (Wolff et al., 2010) and pointed to the role of a variety of factors – including sleep quality (Moore et al., 2002), stress and adversity (Taylor and Seeman, 1999) and various negative emotions (Gallo and Matthews, 2003; Operario et al., 2004; Kraus et al., 2013) – as potential pathways at work.

---

[1] See, e.g., Crossley and Kennedy (2002), Clarke and Ryan (2006), Wolff et al. (2010) and Hurley et al. (2020).

[2] See, e.g., Ostrove et al. (2000), Operario et al. (2004), Singh-Manoux et al. (2003; 2005), Wolff et al. (2010), Kopp et al. (2010), Kraus et al. (2013), Bucciol et al. (2015) and Cundiff and Matthews (2017).

Based on available evidence, we speculatively argue that future research on the theme might benefit from shedding further light on psychological factors that might play a role (Operario et al., 2004; Wolff et al., 2010; Kopp et al., 2010; Cundiff et al., 2013) and *similarly affect status self-evaluations in the two domains*. In this study, we decided to proceed along this path and focus on the explanatory role played by individuals' *personality traits* – defined in the psychology literature as "the relatively enduring patterns of thoughts, feelings, and behaviours that reflect the tendency to respond in certain ways under certain circumstances" (Roberts, 2009; p. 140). To assess personality traits, we refer to the established and comprehensive "Big Five" model (Costa and McCrae, 1992) developed within personality psychology. In the last years, a new and fast-growing line of research in economics and finance examined the transmission and evolution of non-cognitive skills (Cunha et al., 2010; Grönqvist et al., 2017) and their impact in a wide range of economic domains (Borghans et al., 2008). Recent work in this area includes studies on CEOs' and investors' personality traits (Bertrand and Schoar, 2003; Malmendier et al., 2011; Malmendier and Tate, 2015) as well as the links between personality traits and labor market outcomes (Heckman et al., 2006), educational attainment (Almlund et al., 2011; Lundberg, 2013) and socioeconomic status (Bucciol et al., 2015).

In our analysis, we first examine the relationships between health status and personality traits and document that, broadly in line with prior research,[3] more open, conscientious and extraverted individuals report higher levels of health status, while more agreeable and neurotic persons reveal lower health levels. Next, as to the channels tying non-cognitive factors and SHS, we show that the "Big Five" traits affect SHS both indirectly (i.e., via their influence on objective health status) and directly.

However, the core hypothesis that we bring to the data is that the *same personality traits* may be at work and provide "common non-cognitive roots" of SHS and SSS. Importantly, we believe that finding support for this hypothesis would imply that the strong relationship identified in prior work between SHS and SSS may be due to a large extent to the mediating role of this non-cognitive channel. In this regard, a key challenge for our empirical exercise was to keep account of the complex relationships between objective and subjective status

[3] See, e.g., Goodwin and Engstrom, 2002, Löckenhoff et al. 2012, Letzring et al., 2014, and Stephan et al., 2020. As noted by Stephan et al. (2020), as far as the links between self-rated health and "Big Five" traits, evidence is mixed mainly with regard to agreeableness and openness.

measures in the health and socioeconomic domains detected by prior research on the topic. Therefore, our strategy was to provide a large-scale test of our idea crucially controlling for objective measures of health and socioeconomic status. To this aim, in our key specifications we estimate bivariate models based on the 2006-2016 waves of the US *Health and Retirement Study*. In an extension of our models we also include SHS in the regression specification of SSS, and SSS in the specification of SHS. This further step allows us to study the remaining correlation between the two subjective measures, after controlling for objective status, personality and other observable characteristics.

Our findings interestingly indicate that *all* the well-known "Big Five" personality traits are strongly related to both subjective status measures with the same sign, even after controlling for the objective status measures and after including the other subjective measure in the regression specification.

Our work speaks to two distinct strands of literature. First, we directly relate to the aforementioned, voluminous literature that extensively investigated the links between subjective measures of health and socioeconomic status. Second, by focusing on the role of personality traits in influencing the two subjective status measures, we are close to the vast line of inquiry, that has been developing mainly in the area of personality psychology, exploring the relationships between non-cognitive factors and health status or health-related behaviors, such as smoking and drinking.[4]

The remainder of the paper is structured as follows. In Section 2 we present the data we use to explore this topic. Section 3 contains the main findings of our analysis and Section 4 concludes. A separate Appendix provides details on the construction of the key variables used in the analysis, and on the IV regression methodology.

2. Data

We use data from the US *Health and Retirement Study* (HRS), a biannual panel survey on a representative national sample of the American population aged 50 or more. HRS was designed to obtain detailed information regarding the dynamics of retirement and how retirement interacts with health, health insurance, and economic well-being. The survey

[4] See on this Coleman (1997), Jerram and Coleman (1999), Goldberg and Strycker (2002), Hampson and Goldberg (2006), Mroczek and Spiro, (2007) and Kern and Friedman (2008).

provides comprehensive and detailed information on a wide array of domains such as demographics, health, housing, family structure, employment history, disability and net worth, generating a comprehensive picture of the cohort under study. The number of individuals and households interviewed increase over the years as more people become eligible and the ones that are already in the survey are followed in time.

HRS is characterized by a core part available and stable since its introduction (1992), plus further sections added over time. For the aim of this study we focus our attention on the "psychosocial and lifestyle" section. This module was introduced in 2004, including personality variables since 2006. For this reason, the analysis presented in the following sections considers only individuals interviewed every two years since 2006 and up to the latest available wave (2016), for a total of six waves. As a sample restriction we exclude from the analysis people aged more than 80, for two reasons: the older elderly are deliberately oversampled in the HRS design, and we are concerned they could find it difficult to understand all the questions and report the correct answers. Therefore, we focus on individuals with full information on all the variables under investigation and in the 50-80 age range, which is important also because people in this age group have been shown to have stable "Big Five" traits (see, e.g., Cobb-Clark and Schurer, 2012; Terracciano et al., 2006). Considering these restrictions, we end up having 30,675 observations on 16,870 household heads.

2.1. Summary Statistics

As we clarified in the introductory section, we aim to study health and socioeconomic status by including both subjective and objective status measures in our analysis. Therefore, we assess *Subjective Health Status* (SHS), *Objective Health Status* (OHS), *Subjective Socioeconomic Status* (SSS), and *Objective Socioeconomic Status* (OSS).

The first variable, SHS, regards the subjective perception of an individual's health status. This variable is constructed through the following question: *"Would you say your health is excellent, very good, good, fair, or poor?"*. SHS takes five values, from 1 to 5, where the highest value corresponds to the best health status. In order to compare this subjective evaluation with a reliable objective measure of health status, we also consider the OHS variable. This is an index created from a factor analysis with polychoric correlation, using information about some chronic diseases and some physical difficulties (following Poterba et al., 2013; for details see Appendix A).

The SSS variable aims to capture individuals' subjective evaluations of the position they occupy on the social ladder. This variable originates from the following question:

> *"Think of this ladder as representing where people stand in our society. At the top of the ladder are the people who are the best off – those who have the most money, most education, and best jobs. At the bottom are the people who are the worst off – who have the least money, least education, and the worst jobs or no jobs. The higher up you are on this ladder, the closer you are to the people at the very top and the lower you are, the closer you are to the people at the very bottom."*

The answer has to be provided by drawing a cross on one of the ten rungs in a picture of a ladder, giving people a simple, intuitive and clear way to immediately understand what the question asks, by somehow visualizing the entire society and her own position at the same time.[5] The question explicitly mentions three objective dimensions – money, education and jobs – that we have considered as our natural departure point to build an objective measure of socioeconomic status. Following Bucciol et al. (2015), this index (OSS) is drawn from a factor analysis with polychoric correlation, created considering the degree of education (college, high school, lower), and the logs of income, financial and real wealth (see Appendix A for details). Moreover, we rescaled SSS to have the same range (1-5) as SHS, and we standardized the two objective indexes (OHS and OSS) to have mean 0 and variance 1.

Figure 1 displays the distribution of the subjective and objective indexes for health (panel a) and socioeconomic status (panel b). It is clear that the distribution of all indexes is left-skewed, with higher concentration of values toward high values – especially in the two objective measures.

FIGURE 1 ABOUT HERE

To shed some preliminary light on the links between subjective and objective measures, Figure 2 displays a scatter plot comparing the two health measures (panel a) and the two socioeconomic status measures (panel b). Each point corresponds to the sample average conditional on the value of the subjective measure. From both figures we see a clear positive

[5] An almost identical social ladder question has been used, e.g., by Ostrove et al. (2000), Adler et al. (2000) and Operario et al. (2004), among others. As pointed out by Operario et al. (2004), "Even though it is a single item, the subjective status measure may provide a good summative indicator of status across different aspects of socioeconomic standing" (p. 244).

trend, where higher values of the subjective measure are associated with higher average values of the objective measure.

FIGURE 2 ABOUT HERE

Other key variables included in our analysis are the ones related to individuals' *personality traits*. In the last 20 years there has been a growing consensus in the psychology literature over the existence of five basic or primary personality traits which are invariant across age groups and cultures (Costa and McCrae, 1992). These well-known "Big Five" traits are generally denoted with the terms Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. We therefore build five indexes from the answers to a question asking to report how well each of 26 adjectives fits the respondent (following Smith et al., 2013; see Appendix A). Each index takes value in the 0-1 range.

Table 1 reports summary statistics on the variables used in this analysis. We divide the explanatory variables in two groups: *personality traits* and *sociodemographic controls*. From the table we learn that the subjective evaluations of health (SHS) and socioeconomic status (SSS) are on average slightly above the central value of 3; similarly, the average values of personality are above the central value of 0.5 for all indexes apart from Neuroticism. The average respondent in our sample is 66.22 years old, native American, married and does not work (in most cases, she is retired).

TABLE 1 ABOUT HERE

Table 2 displays the polychoric correlation of each variable with the subjective and the objective indexes. We can observe that the two measures of health status are highly positively correlated (0.601); the two measures of socioeconomic status also exhibit positive correlation, although with smaller magnitude (0.401). The correlation between the two subjective measures is around 0.302, in line with the correlation between the two objective measures. Subjective and objective measures also show relatively high correlation with personality and some sociodemographic variables (noticeably, marital and employment status).

TABLE 2 ABOUT HERE

3. Empirical Analysis

We carried out our empirical analysis, that will be illustrated in the next sub-sections, in four steps, by having recourse to four regression models (Model 1-4). The variables involved are Subjective Health Status (*SHS*), Objective Health Status (*OHS*), Subjective Socioeconomic Status (*SSS*), Objective Socioeconomic Status (*OSS*), Personality traits (*P*), and sociodemographic (*D*) and year (*Y*) controls. Further ingredients of the models are the error term (ε) and the parameters (β); the regressions are computed on each observation, for individual *i* at time *t*.

Model 1. We begin by considering *SHS* only as our dependent variable, that we regress on personality traits by controlling for basic classic sociodemographic characteristics, year information, and, importantly, for OHS (*Sub-section 3.1*):

$$SHS_{it} = \alpha + \beta_1 OHS_{it} + \beta_2 P_{it} + \beta_3 D_{it} + \beta_4 Y_{it} + \varepsilon_{it} \tag{1}$$

Model 2. The major goal of this study is to *jointly* consider as our dependent variables *the two subjective status measures (SHS* and *SSS)* that are central in the large literature recalled in Section 1 and that prior work in economics, psychology, and medicine has shown to be strongly related the one with the other. To this aim, in Model 2 we estimate a bivariate model in which we regress both *SHS* and *SSS* on the two objective status measures (*OHS* and *OSS*), controlling for sociodemographic variables and year information (*Sub-section 3.2*):

$$\begin{cases} SHS_{it} = \alpha^H + \beta_1^H OHS_{it} + \beta_2^H OSS_{it} + \beta_3^H D_{it} + \beta_4^H Y_{it} + \varepsilon_{it}^H \\ SSS_{it} = \alpha^S + \beta_1^S OHS_{it} + \beta_2^S OSS_{it} + \beta_3^S D_{it} + \beta_4^S Y_{it} + \varepsilon_{it}^S \end{cases} \tag{2}$$

Model 3. As a further step, in Model 3 we carry out the same regression as in Model 2, but crucially add *personality characteristics* as our key explanatory variables (*Sub-section 3.3*):

$$\begin{cases} SHS_{it} = \alpha^H + \beta_1^H OHS_{it} + \beta_2^H OSS_{it} + \beta_3^H P_{it} + \beta_4^H D_{it} + \beta_5^H Y_{it} + \varepsilon_{it}^H \\ SSS_{it} = \alpha^S + \beta_1^S OHS_{it} + \beta_2^S OSS_{it} + \beta_3^S P_{it} + \beta_4^S D_{it} + \beta_5^S Y_{it} + \varepsilon_{it}^S \end{cases} \tag{3}$$

Model 4. Finally, our empirical strategy also leads us to analyze Model 4, in which we include subjective measures in the regression specification, in the sense that we carry out the same regression as in Model 3 but we also incorporate in each equation *the other subjective measure* (i.e., *SSS* in the *SHS* equation and *SHS* in the *SSS* equation) among our regressors (*Sub-section 3.4*). Simultaneity between dependent and explanatory subjective variables here prevents us

from running a bivariate model; for this reason, we separately estimate the following two univariate equations:

$$\begin{aligned} SHS_{it} &= \alpha^H + \beta_1^H OHS_{it} + \beta_2^H OSS_{it} + \beta_3^H SSS_{it} + \beta_4^H P_{it} + \beta_5^H D_{it} + \beta_6^H Y_{it} + \varepsilon_{it}^H \\ SSS_{it} &= \alpha^S + \beta_1^S OHS_{it} + \beta_2^S OSS_{it} + \beta_3^S SHS_{it} + \beta_4^S P_{it} + \beta_5^S D_{it} + \beta_6^S Y_{it} + \varepsilon_{it}^H \end{aligned} \quad (4)$$

Models (1)-(4) may suffer from endogeneity. Indeed, subjective and objective measures are likely to have common determinants (including, but not limited to, personality traits and sociodemographic control variables). Since endogeneity gives rise to biased and inconsistent OLS estimates, in the following we report results from standard OLS estimates in combination with IV estimates based on the Lewbel (2012) approach. This technique, described in detail in Appendix B, exploits model heteroskedasticity to artificially create instruments for the first stage equation. Our data support the assumption of model heteroskedasticity (see Appendix B). The Lewbel IV estimator is useful when the traditional IV model does not meet the order condition for identification – that is, as in our case, when there are no valid instruments available. The method has been applied extensively in the economics literature; see, e.g., Bucciol et al. (2015); Chowdury et al. (2014); and Kevin and Oppedisano (2013) among others.

Although the dataset presents a panel structure, on average we have just 1.82 observations per individual. One of the main reasons is that our variables of interest belong to the "psychosocial and lifestyle" section, that in every wave is implemented on a rotating (random) half of the full sample. This implies that the same individual fills in the section every four years, so that, in our dataset (which includes six waves), we can have at most three observations per respondent. This limited number of repeated observations creates small variability within the same household, and consequently prevents us from using models that are specific for panel data. For this reason, we carry out a cross-sectional analysis with standard errors clustered at the individual level to account for possible correlations across observations from the same individual. In the following, we adopt the convention to comment only on coefficients that are significant at the 5% or lower level.

3.1 . Subjective Health Status

In Table 3 we report the results of several regressions considering SHS as our dependent variable, and using different specifications of the explanatory variables. In Column (1) the specification includes only the sociodemographic control variables and the year effects. We find significant effects of many controls: married, better educated and richer individuals,

females, employees and self-employed workers declare very good health. The largest effects are those on occupation and education, with each variable being able to increase OHS by 0.3-0.5 points on a range from 1 to 5. Overall, this simple model is able to explain 18.2% of the variability in the dependent variable.

In Column (2) we add the objective measure of health status (OHS).[6] Our previous findings are confirmed. In addition, we detect a significant – though small – age effect (10 more years of age increase SHS by 0.042 points, which corresponds to about 4% of the standard deviation of the dependent variable). The new variable, OHS, also displays a significantly positive effect: increasing objective health status by one standard deviation raises subjective health status by 0.569 points (about half the standard deviation of SHS). We interestingly notice that, after the inclusion in the model of just one more variable (OHS), the R-squared statistic grew to 0.412. This means that the model in Column (2) can explain 41.2% of the variability in the dependent variable, and highlights the well-known importance of the objective measure in explaining the subjective one.

In Column (3) we add personality variables to the prior model, thus estimating the model in Equation (1).[7] We find that almost all the personality variables are correlated with SHS. In particular, individuals who are more open, conscientious and extraverted declare a higher health status, while those who are more neurotic report lower health status. We find no significant effect only from the variable capturing Agreeableness.

In Column (4) we repeat the analysis of Column (3) using a Lewbel IV estimator. In this model, OHS is treated as endogenous. Standard tests find that the chosen instruments are relevant (Kleibergeen-Paap test) and not exogenous (Hansen test),[8] and that the OLS estimator is inconsistent (Hausman-Wu test). Our previous results are confirmed; in addition, we now document a negative effect of the Agreeableness trait. This effect, however, is quantitatively smaller than those of the other four traits.

Löckenhoff et al. (2012) point out that, in principle, the "Big Five" personality traits may influence SHS along two partly overlapping pathways: first, personality characteristics

---

[6] The positive association between self-rated health and objective health status is an established finding (see, e.g., Wolff et al., 2010). At the same time, the existing literature also clearly reveals that there are key dimensions affecting SHR that are *not* incorporated in OHS (see, e.g., Greene et al., 2015).

[7] As we noted in the introductory section, the influence of personality traits on SHS has been investigated by prior psychology work (see, e.g., Goodwin and Engstrom, 2002, Hampson et al., 2007, Löckenhoff et al., 2012, Letzring et al., 2014, and Stephan et al., 2020).

[8] This finding is common with the Lewbel approach, which uses a large number of instruments.

may *directly* shape individuals' self-evaluations and subjective interpretations of their health status; second, personality might *indirectly* affect SHS via its influence on objective health status. To dig deeper into this issue, in Column (5) we replicate our main equation with the exclusion of the potentially endogenous OHS variable. Regarding personality traits, we detect some differences compared to our previous results. On the one hand, we no longer observe a significant effect of Openness. On the other, we find larger coefficients (about doubled) for all the other personality traits. This evidence suggests that personality also affects objective health status, and that the total effect on subjective health status is roughly equally split between direct and indirect components.

TABLE 3 ABOUT HERE

3.2. Subjective and Objective Measures of Health and Socioeconomic Status

In the following analysis we focus on health and socioeconomic status indexes and their links with basic demographic information, according to Equation (2). We report our results in Table 4. In Columns (1) and (2) we consider a bivariate OLS regression while in Columns (3) and (4) we carry out a bivariate IV regression based on the approach advanced by Lewbel (2012), where we treat OHS and OSS as potential endogenous variables.[9] Since the results are similar, and given the evidence we found in Table 3 on the inconsistency of the OLS estimates, in the following we comment on the IV estimates only.

In line with prior work,[10] we show that both objective indexes, OHS and OSS, have a positive and significant effect on the two dependent variables. The coefficient is systematically larger for OHS, although this is statistically confirmed only for subjective health status.[11] Moreover, we see that the correlation between the errors of the two equations, which corresponds to the correlation between SHS and SSS after controlling for objective status and the sociodemographic variables, is 0.133. This is much smaller than the raw correlation between SHS and SSS we measured in Table 2 (0.302) and indicates that large part of the correlation between the subjective measures is captured by some common observable dimensions.

[9] We use the command for multi-equation estimators "cmp" in Stata v.16.

[10] See, e.g., Adler et al. (2000), Operario et al. (2004), Singh-Manoux et al. (2003; 2005) and Sosnaud et al. (2013).

[11] Chi-squared test on the equality of the coefficients. SHS: 95.62; p-value <0.01. For SSS: 2.86; p-value: 0.091.

TABLE 4 ABOUT HERE

3.3. The Effects of Personality Traits on Subjective Measures

It is plausible that some personality characteristics affect both subjective health and socioeconomic status. Here we add personality variables to the prior specification, following Equation (3). Our results are reported in Table 5. Similarly to the previous table, in Columns (1) and (2) we consider a bivariate OLS regression while in Columns (3) and (4) we carry out a bivariate IV regression. We comment on the IV estimates only; estimates from OLS are similar.

Our previous results from Table 4 are confirmed. In particular it still turns out that both objective measures contribute to explain both subjective measures, although their influence is smaller than what we observed in Table 4. The effect of OHS is larger than the effect of OSS, and we find statistical evidence of this in the model describing SHS.[12] All personality traits also matter to predict the subjective measures and, interestingly, their effect is consistent across the two status dimensions: positive for Openness, Conscientiousness and Extraversion, and negative for Agreeableness and Neuroticism. Moreover, it seems that the magnitude of the effects of Openness and Agreeableness is statistically larger for SSS than for SHS while the magnitude of the effects of Conscientiousness and Neuroticism is statistically larger for SHS than for SSS.[13] These results provide further evidence that personality and objective and subjective status measures are strongly intertwined, so that omitting one of them risks introducing a significant bias in the analysis.

The correlation between the errors of the two equations, 0.083, is even smaller than in the model of Table 4: this suggests that personality traits indeed capture part of the observed correlation between subjective health and subjective socioeconomic status.

In a further analysis, whose output is available upon request, we ran the bivariate model of Table 5 without the potentially endogenous objective variables. This exercise, which is in the same spirit as Column (5) of Table 3, still displays a significant effect for all the personality

[12] Chi-squared test on the equality of the coefficients. For SHS: 56.46; p-value <0.01. For SSS: 1.6; p-value: 0.206.

[13] Chi-squared test on the equality of the coefficient. For Openness: 109.73; p-value <0.01. For Conscientiousness: 15.25; p-value <0.01. For Extraversion: 3.74; p-value 0.053. For Agreeableness: 9.35; p-value <0.01. For Neuroticism: 7.49; p-value <0.01.

variables. However, in this new analysis we find that the coefficient on Conscientiousness in the SSS equation is more than doubled as compared to Table 5. In contrast, in the SHS equation we observe that four out of the five coefficients on personality (the exception is Openness) are doubled or even larger as compared to Table 5. This suggests that personality also affects both objective health and socioeconomic status, but it is related more to objective health. Therefore, our view of the channels tying personality and the subjective measures of health and socioeconomic status is broadly in line with the interpretation we provided at the end of Sub-section 3.1: the total effect of personality on SHS is roughly equally split between a direct component and an indirect one, mediated by OHS. The effect of personality on SSS seems instead to be mostly driven by a direct component.

TABLE 5 ABOUT HERE

3.4. Cross-Influence of Subjective Measures

As we have seen, health and socioeconomic status are closely related to each other. It could also be the case that subjective socioeconomic status influences self-rated health and, similarly, that subjective health status affects social perceptions: therefore, each subjective component might play an important role in explaining the other subjective measure. For this reason, we add to the specification of each subjective measure the other subjective measure, and we carry out OLS regressions and IV regressions acknowledging for the possible endogeneity of both objective and subjective variables. This enriched specification could also solve, at least partially, a potential problem of omitted variables; indeed, the subjective component, included among the explanatory variables, could capture the same omitted variables which might affect the dependent variable, which is subjective too.

Due to simultaneity between the two subjective measures in a system of equations, we are unable to run a bivariate regression and, therefore, we rely here on two separate univariate regressions as in Equation (4). We thus see this analysis as exploratory but still indicative on the correlation between subjective measures net of objective measures, personality traits and further control variables. Our results are reported in Table 6. Columns (1)-(2) run OLS regressions, while Columns (3)-(4) run Lewbel IV regressions.

We find results similar to the previously illustrated ones regarding the objective measures, personality traits and sociodemographic controls. Importantly, in both equations the OLS output detects a significantly positive role for the other subjective measure. In other words, there seems to be correlation between subjective measures of different domains (health

and socioeconomic status), even after controlling for their objective counterpart, personality and other control variables.

Standard statistical tests performed with IV, however, reveal that OLS estimates are inconsistent (see the p-value of the Hausman test). We thus rely more on the IV estimates of Columns (3)-(4). Here the output displays no significant role for the subjective measures, while the objective measures and personality are still largely significant and, together with other control variables, contribute to explain our dependent variables. In particular, our results highlight the key role of personality traits in explaining the gap between objective and subjective measures, despite the presence of the subjective measure from the other status domain. We then conclude that subjective measures from different domains are not correlated with each other, conditional on objective measures, personality and other observable characteristics. In a similar regression analysis (available upon request), where we excluded personality from the specification, we found a significant effect of SSS on the model for SHS. Combined with our results from Table 6, these findings suggest that personality traits indeed play an important role in accounting for the gap between subjective measures of different domains.

TABLE 6 ABOUT HERE

4. Conclusion

Using large-scale US data from multiple waves of the HRS, we aimed to investigate the complex interplays between personality traits and subjective appraisals of health and socioeconomic status. In our empirical analysis, we proceeded as follows. We began by exploring the link between health status and personality traits and, broadly in line with prior research, we documented that more open, conscientious and extraverted individuals report higher levels of health status, while more agreeable and neurotic people declare lower health levels, even after controlling for objective health status. Our evidence also suggests that the "Big Five" traits affect SHS both indirectly (i.e., via their influence on OHS) and directly.

As a second step, we added socioeconomic status into the analysis and, estimating a bivariate model which includes basic sociodemographic characteristics, we found that the two objective indexes of health and socioeconomic status have a positive and significant effect on both subjective counterparts. Next, we added personality variables in the regression and showed that both objective indexes still have positive and significant effects on the two

subjective status, even though their influence is smaller than the previous one, and, more importantly, "Big Five" traits turned out to have strong effects on SSS and SHS.

Due to endogeneity concerns – since there could exist reverse causality between the objective and the subjective status, and personality traits affect both measures – we carried out IV regressions based on the approach advanced by Lewbel (2012). Most of the previous results are confirmed even with this specification. In particular, individuals who are more open, conscientious and extraverted declare higher health and socioeconomic status, whereas those who are more agreeable and neurotic report lower health and socioeconomic status. Moreover, both sign and significance of the effects of all personality variables are the same for the two subjective measures under study. Our results point to a novel, direct channel through which non-cognitive factors similarly influence individuals' status self-evaluations across distinct, though strongly intertwined, domains.

Finally, to address a potential omitted variables problem, we added the two subjective components among the explanatory variables of our bivariate model. We showed that each subjective measure has a positive and significant effect on the other subjective variable. However, although all effects slightly decrease, the two objective indexes are still positively correlated with both dependent variables and all personality traits play an important role on both status evaluations.

We believe that an important reason why our core results are relevant for the aforementioned, vast body of empirical literature on health and socioeconomic status is that they significantly contribute to our understanding of both the determinants of SHS and SSS as well as the mechanisms behind the established link between these two status measures.

The main limitations of this study are the following. First, in principle endogeneity concerns could be addressed also using standard IV approaches or exploiting the panel dimension. Unfortunately our data prevent us from performing either analyses, because we do not have valid instruments and there are too few observations per individual. However, we mitigate these concerns by adopting Lewbel's (2012) approach. A second limitation pertains to the study sample, as only individuals who are 50 or older participate in the HRS survey. Finally, while this empirical study succeeds in identifying "common non-cognitive roots" of the two subjective measures of health and socioeconomic status, it is fair to say that only future work will be able to more accurately illuminate the complex pathways underlying the detected relationships between personality traits and the two subjective status measures. In particular, we speculatively argue that it will be interesting to examine the links between personality traits and another dimension that likely affects both subjective status measures, i.e., individuals'

(broadly conceived) *lifestyle*. In this regard, we suggest to assess the latter not only in terms of individual behavior (e.g., exercising, sleeping, eating and smoking habits; see on this, e.g., Borg and Kristensen, 2000), but also considering "individual social capital" (to be measured by paying special attention to quantity and quality of friendships and other relevant social interactions; see on this Bucciol et al., 2020). We leave the investigation of the role of the interplays between non-cognitive factors and lifestyle in shaping the two subjective measures of health and socioeconomic status as an interesting new avenue for future research on the theme.

References

Adler, N. E., Epel, E. S., Castellazzo, G., & Ickovics, J. R. (2000). Relationship of subjective and objective social status with psychological and physiological functioning: Preliminary data in healthy white women. *Health Psychology*, 19(6), 586-592.

Almlund, M., Duckworth, A., Heckman, J., & Kautz, D. (2011). Personality psychology and economics. In Hanushek, E., Machin, S., & Woessman, L. (eds.), *Handbook of the Economics of Education*, 4. Elsevier: Amsterdam.

Bertrand, M., & Schoar, A. (2003). Managing with style: The effect of managers on firm policies. *Quarterly Journal of Economics*, 118, 1169-1208.

Borg, V., & Kristensen, T. S. (2000). Social class and self-rated health: Can the gradient be explained by differences in life style and work environment? *Social Science & Medicine*, 51, 1019-1030.

Borghans, L., Duckworth, A. L., Heckman, J. J., & Weel, B. (2008). The economics and psychology of personality traits. *Journal of Human Resources*, 43, 972-1059.

Bucciol, A., Cavasso, B., & Zarri, L. (2015). Social status and personality traits. *Journal of Economic Psychology*, 51, 245-260.

Bucciol, A., Cicognani, S., & Zarri, L. (2020). Social status perception and individual social capital: Evidence from the US. *B.E. Journal of Economic Analysis & Policy*, 20(1), doi: 10.1515/bejeap-2019-0071.

Chowdhury, M. T. H., Bhattacharya, P. S., Mallick, D., & Ulubasoglu, M. A. (2014). An empirical inquiry into the role of sectoral diversification in exchange rate regime choice. *European Economic Review*, 67, 210-227.

Clarke, P. M., & Ryan, C. (2006). Self-reported health: Reliability and consequences for health inequality measurement. *Health Economics*, 15, 645-652.

Cobb-Clark, D. A., & Schurer, S. (2012). The stability of big-five personality traits. *Economics Letters*, 115(1), 11-15.

Coleman, P. G. (1997). Personality, health and ageing. *Journal of the Royal Society of Medicine*, 90 (32), 27-33.

Costa, P. T., & McCrae, R. R. (1992). Four ways five factors are basic. *Personality and Individual Differences*, 13(6), 653-665.

Crossley, T. F., & Kennedy, S. (2002). The reliability of self-assessed health status. *Journal of Health Economics*, 21(4), 643-658.

Cruces, G., Perez-Truglia, R., & Tetaz, M. (2013). Biased perceptions of income distribution and preferences for redistribution: Evidence from a survey experiment. *Journal of Public Economics*, 98, 100-112.

Cundiff, J. M., Smith, T. W., Uchino, B. N., & Berg, C. A. (2013). Subjective social status: Construct validity and associations with psychosocial vulnerability and self-rated health. *International Journal of Behavioral Medicine*, 20, 148-158.

Cundiff, J. M., & Matthews, K. A. (2017). Is subjective social status a unique correlate of physical health? A meta-analysis. *Health Psychology*, 36(12), 1109-1125.

Cunha, F., Heckman, J. J., & Schennach, S. M. (2010). Estimating the technology of cognitive and noncognitive skill formation. *Econometrica*, 78(3), 883-931.

Gallo, L. C., & Matthews, K. A. (2003). Understanding the association between socioeconomic status and physical health: Do negative emotions play a role? *Psychological Bulletin*, 129(1), 10-51.

Goldberg, L. R., & Strycker, L. A. (2002). Personality traits and eating habits: The assessment of food preferences in a large community sample. *Personality and Individual Differences*, 32(1), 49-65.

Goodwin, R., & Engstrom, G. (2002). Personality and the perception of health in the general population. *Psychological Medicine*, 32(2), 325-332.

Greene, W. H., Harris, M. N., & Hollingsworth, B. (2015). Inflated responses in measures of self-assessed health. *American Journal of Health Economics*, 1(4), 461-493.

Grönqvist, E., Ockert, B., & Vlachos, J. (2017). The intergenerational transmission of cognitive and noncognitive abilities. *Journal of Human Resources*, 52(4), 887-918.

Hampson, S. E., & Goldberg, L. R. (2006). Forty years on: teachers' assessments of children's personality traits predict self-reported health behaviors and outcomes at midlife. *Journal of Health Psychology*, 25(1), 57-64.

Hampson, S. E., Goldberg, L. R., Lewis, R., Vogt, T. M., & Dubanoski, J. P. (2007). Mechanisms by which childhood personality traits influence adult health status: Educational attainment and healthy behaviors. *Health Psychology*, 26(1), 121-125.

Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics*, 24(3), 411-482.

Hurley, J., Mentzakis, E., & Walli-Attaei, M. (2020). Inequality aversion in income, health, and income-related health. *Journal of Health Economics*, 70, doi: 10.1016/j.jhealeco.2019.102276.

Jerram, K. L., & Coleman, P. G. (1999). The big five personality traits and reporting of health problems and health behavior in old age. *British Journal of Health Psychology*, 4, 181-192.

Kevin, D., & Oppedisano, V. (2013). The surprising effect of larger class sizes: Evidence using two identification strategies. *Labour Economics*, 23, 57-65.

Kern, M. L., & Friedman, H. S. (2008). Do conscientious individuals live longer? *Health Psychology*, 27(5), 505-512.

Kopp, M., Skrabski, A., Rethelyi, J., Kawachi, I., & Adler, N. E. (2010). Self-rated health, subjective social status, and middle-aged mortality in a changing society. *Behavioral Medicine*, 30(2), 65-72.

Kraus, M.W., Adler, N. E., & Chen, T.W.D. (2013). Is the association of subjective SES and self-rated health confounded by negative mood? An experimental approach. *Health Psychology*, 32(2), 138-145.

Letzring, T. D., Edmonds, G. W., Hampson, S. E. (2014). Personality change at mid-life is associated with changes in self-rated health: Evidence from the Hawaii Personality and Health Cohort. *Personality and Individual Differences*, 58, 60-64.

Lewbel, A. (2012). Using heteroschedasticity to identify and estimate mismeasured and endogenous regressor models. *Journal of Business and Economic Statistics*, 30(1), 67-80.

Löckenhoff, C. E., Terracciano, A., Ferrucci, L., Costa, P. T. (2012). Five-factor personality traits and age trajectories of self-rated health: The role of question framing. *Journal of Personality*, 80(2), 375-401.

Lundberg, S. (2013). The college type: Personality and educational inequality. *Journal of Labor Economics*, 31(3), 421-441.

Malmendier, U., & Tate, G. (2015). Behavioral CEOs: The role of managerial overconfidence. *Journal of Economic Perspectives*, 29(4), 37-60.

Malmendier, U., Tate, G., & Yan, J. (2011). Overconfidence and early-life experiences: The effect of managerial Traits on corporate financial policies. *Journal of Finance*, 66, 1687-1733.

Moore, P. J., Adler, N. E., Williams, D. R., & Jackson, J. S. (2002). Socioeconomic status and health: The role of sleep. *Psychosomatic Medicine*, 64(2), 337-344.

Mroczek, D. K., & Spiro, A. (2007). Personality change influences mortality in older men. *Psychological Science*, 18(5), 371-376.

Operario, D., Adler, N. E., & Williams, D. R. (2004). Subjective social status: Reliability and predictive utility for global health. *Psychology and Health*, 19(2), 237-246.

Ostrove, J. M., Adler, N. E., Kuppermann, M., & Washington, A. E. (2000). Objective and subjective assessments of socioeconomic status and their relationship to self-rated health in an ethnically diverse sample of pregnant women. *Health Psychology*, 19(6), 613-618.

Poterba, J., Venti, S., & Wise, D. A. (2013). Health, education, and the postretirement evolution of household assets. *Journal of Human Capital*, 7(4), 297-339.

Roberts, B. W. (2009). Back to the future: Personality and assessment and personality development. *Journal of Research in Personality*, 43(2), 137-145.

Singh-Manoux, A., Adler, N. E., & Marmot, M. G. (2003). Subjective social status: Its determinants and its association with measures of ill health in the Whitehall II study. *Social Science & Medicine*, 56(6), 1321-1333.

Singh-Manoux, A., Marmot, M. G., & Adler, N. E. (2005). Does subjective social status predict health and change in health status better than objective status? *Psychosomatic Medicine*, 67(6), 855-861.

Smith, J., Fisher, G., Ryan, L., Clarke, P., House, J., & Weir, D. R. (2013). Psychosocial and lifestyle questionnaire 2006-2010: Documentation report. The HRS Psychosocial Working Group.

Sosnaud, B., Brady, D., & Frenk, S. M. (2013). Class in name only: Subjective class identity, objective class position, and vote choice in American presidential elections. *Social Problems*, 60(1), 81-99.

Stephan, Y., Sutin, A. R., Luchetti, M., Hognon, L., Canada, B., & Terracciano, A. (2020), Personality and self-rated health across eight cohort studies, *Social Science & Medicine*, forthcoming. DOI: 10.1016/j.socscimed.2020.113245.

Taylor, S. E., & Seeman, T. E. (1999). Psychosocial resources and the SES-health relationship. *Annals of the New York Academy of Sciences*, 896, 210-225.

Terracciano, A., Costa, P. T., & McCrae, R. R. (2006). Personality plasticity after age 30. *Personality and Social Psychology Bulletin*, 32(8), 999-1009.

Wolff, L. S., Subramanian, S. V., Garcia, D. A., Weber, D., & Kawachi, I. (2010). Compared to whom? Subjective social status, self-rated health, and referent group sensitivity in a diverse US sample. *Social Science & Medicine*, 70(12), 2019-2028.

Table 1. Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.
Objective and subjective measures				
Subjective Health Status (SHS)	3.215	1.058	1	5
Objective Health Status (OHS)	0	1	-4.090	1.048
Subjective Socioec. Status (SSS)	3.400	0.788	1	5
Objective Socioec. Status (OSS)	0	1	-3.477	2.305
Personality traits				
Openness	0.648	0.186	0	1
Conscientiousness	0.682	0.137	0	1
Extraversion	0.731	0.188	0	1
Agreeableness	0.840	0.163	0	1
Neuroticism	0.445	0.158	0	1
Sociodemographic controls				
Age/10	6.622	0.790	5	8
Female	0.586	0.493	0	1
Immigrate	0.108	0.310	0	1
Married	0.656	0.475	0	1
Employee	0.309	0.462	0	1
Self-employed	0.089	0.285	0	1

Note. 30,675 observations.

Table 2. Correlations with objective and subjective indexes

Variable	Correlation with			
	SHS	OHS	SSS	OSS
Objective and subjective measures				
Subjective Health Status (SHS)	1	0.601***	0.302***	0.343***
Objective Health Status (OHS)	0.601***	1	0.257***	0.303***
Subjective Socioec. Status (SSS)	0.302***	0.257***	1	0.401***
Objective Socioec. Status (OSS)	0.343***	0.303***	0.401***	1
Personality traits				
Openness	0.225***	0.161***	0.277***	0.134***
Conscientiousness	0.247***	0.211***	0.208***	0.162***
Extraversion	0.248***	0.189***	0.241***	0.072***
Agreeableness	0.120***	0.043***	0.099***	0.030***
Neuroticism	-0.199***	-0.188***	-0.175***	-0.132***
Sociodemographic controls				
Age/10	-0.069***	-0.155***	0.085***	0.124***
Female	0.007	-0.094***	-0.062***	-0.070***
Immigrate	-0.073***	0.033***	-0.061***	-0.165***
Married	0.123***	0.152***	0.175***	0.316***
Employee	0.179***	0.267***	0.025***	0.018***
Self-employed	0.111***	0.129***	0.083***	0.102***

Note. 30,675 observations; *** p<0.01, ** p<0.05, * p<0.1.

Table 3. Subjective health status

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	SHS	SHS	SHS	SHS	SHS
Instruments	No	No	No	Yes	No
OHS		0.569***	0.524***	0.375***	
		(0.006)	(0.006)	(0.015)	
Openness			0.150***	0.124***	0.058
			(0.038)	(0.039)	(0.044)
Conscientiousness			0.436***	0.569***	0.907***
			(0.047)	(0.049)	(0.054)
Extraversion			0.515***	0.634***	0.935***
			(0.039)	(0.041)	(0.045)
Agreeableness			-0.075*	-0.136***	-0.292***
			(0.042)	(0.043)	(0.049)
Neuroticism			-0.518***	-0.657***	-1.008***
			(0.035)	(0.038)	(0.040)
Age/10	-0.000	0.042***	0.022***	0.007	-0.032***
	(0.010)	(0.008)	(0.008)	(0.008)	(0.009)
Female	0.104***	0.167***	0.153***	0.138***	0.102***
	(0.014)	(0.012)	(0.012)	(0.012)	(0.014)
Immigrate	-0.042*	-0.178***	-0.158***	-0.120***	-0.025
	(0.023)	(0.020)	(0.019)	(0.020)	(0.022)
Married	0.033**	-0.001	0.010	0.020	0.044***
	(0.016)	(0.013)	(0.013)	(0.013)	(0.015)
Employee	0.394***	0.081***	0.071***	0.144***	0.330***
	(0.016)	(0.013)	(0.013)	(0.015)	(0.015)
Self-employed	0.402***	0.130***	0.095***	0.156***	0.310***
	(0.024)	(0.020)	(0.020)	(0.021)	(0.023)
High school	0.302***	0.210***	0.176***	0.194***	0.241***
	(0.021)	(0.017)	(0.017)	(0.017)	(0.020)
College	0.518***	0.346***	0.294***	0.331***	0.424***
	(0.025)	(0.020)	(0.020)	(0.021)	(0.024)
Income (IHS)	0.056***	0.044***	0.039***	0.041***	0.046***
	(0.006)	(0.005)	(0.004)	(0.005)	(0.005)
Financial wealth (IHS)	0.033***	0.016***	0.015***	0.020***	0.030***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Real wealth (IHS)	0.029***	0.010***	0.008***	0.013***	0.024***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	1.440***	1.900***	1.660***	1.552***	1.280***
	(0.090)	(0.073)	(0.079)	(0.081)	(0.093)
Year effects	YES	YES	YES	YES	YES
Kleibergeen-paap test				0.000	
Hansen test				0.000	
Hausman-Wu test				0.000	
R-squared	0.182	0.412	0.434		0.253
Observations	30,675	30,675	30,675	30,675	30,675

Note. Univariate linear regressions, without (Columns 1-3, 5) and with (Column 4) instruments. The endogenous variable in Column 4 is OHS. Standard errors clustered at the individual level in round parentheses; p-values in squared parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Subjective health and socioeconomic status: bivariate analysis

	(1)	(2)	(3)	(4)
Dependent Variable	SHS	SSS	SHS	SSS
Instruments	No	No	Yes	Yes
OHS	0.576***	0.123***	0.507***	0.146***
	(0.006)	(0.006)	(0.017)	(0.016)
OSS	0.175***	0.252***	0.151***	0.088***
	(0.006)	(0.006)	(0.024)	(0.023)
Age/10	0.024***	0.082***	0.029***	0.121***
	(0.008)	(0.007)	(0.010)	(0.009)
Female	0.164***	-0.012	0.157***	-0.005
	(0.012)	(0.010)	(0.012)	(0.011)
Immigrate	-0.216***	-0.019	-0.223***	-0.103***
	(0.020)	(0.017)	(0.023)	(0.020)
Married	0.001	0.082***	0.035*	0.186***
	(0.013)	(0.011)	(0.019)	(0.017)
Employee	0.112***	0.030***	0.163***	0.056***
	(0.013)	(0.012)	(0.016)	(0.014)
Self-employed	0.158***	0.102***	0.211***	0.157***
	(0.020)	(0.016)	(0.023)	(0.019)
Constant	2.946***	2.831***	2.880***	2.509***
	(0.057)	(0.051)	(0.072)	(0.065)
Year effects	YES	YES	YES	YES
Correlation btw. Equations	0.129***		0.133***	
	(0.006)		(0.008)	
Log pseudo-likelihood	-70,106.952		-146,876.440	
Observations	30,675	30,675	30,675	30,675

Note. Bivariate linear regressions, without (Columns 1-2) and with (Columns 3-4) instruments. The endogenous variables in Columns 3-4 are OHS and OSS. Standard errors clustered at the individual level in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Subjective health and socioeconomic status: personality traits

	(1)	(2)	(3)	(4)
Dependent Variable	SHS	SSS	SHS	SSS
Instruments	No	No	Yes	Yes
OHS	0.528***	0.074***	0.411***	0.099***
	(0.006)	(0.005)	(0.018)	(0.016)
OSS	0.158***	0.231***	0.142***	0.057***
	(0.006)	(0.006)	(0.024)	(0.022)
Openness	0.260***	0.701***	0.273***	0.794***
	(0.037)	(0.031)	(0.040)	(0.035)
Conscientiousness	0.447***	0.202***	0.597***	0.337***
	(0.047)	(0.041)	(0.053)	(0.047)
Extraversion	0.456***	0.491***	0.534***	0.430***
	(0.039)	(0.033)	(0.042)	(0.038)
Agreeableness	-0.064	-0.265***	-0.122***	-0.292***
	(0.042)	(0.036)	(0.043)	(0.038)
Neuroticism	-0.549***	-0.468***	-0.691***	-0.552***
	(0.035)	(0.031)	(0.040)	(0.035)
Age/10	0.009	0.077***	0.006	0.117***
	(0.008)	(0.007)	(0.010)	(0.008)
Female	0.151***	-0.007	0.142***	0.004
	(0.012)	(0.010)	(0.013)	(0.011)
Immigrate	-0.187***	0.010	-0.179***	-0.073***
	(0.019)	(0.016)	(0.022)	(0.019)
Married	0.014	0.103***	0.050***	0.211***
	(0.012)	(0.011)	(0.019)	(0.016)
Employee	0.097***	0.019*	0.164***	0.039***
	(0.013)	(0.011)	(0.016)	(0.013)
Self-employed	0.114***	0.041***	0.179***	0.089***
	(0.020)	(0.016)	(0.022)	(0.018)
Constant	2.542***	2.336***	2.462***	1.956***
	(0.066)	(0.059)	(0.083)	(0.073)
Year effects	YES	YES	YES	YES
Correlation btw. Equations	0.079***		0.083***	
	(0.007)		(0.009)	
Lo pseudo-likelihood	-68,330.519		-143,218.000	
Observations	30,675	30,675	30,675	30,675

Note. Bivariate linear regressions, without (Columns 1-2) and with (Columns 3-4) instruments. The endogenous variables in Columns 3-4 are OHS and OSS. Standard errors clustered at the individual level in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Cross-correlation of subjective measures

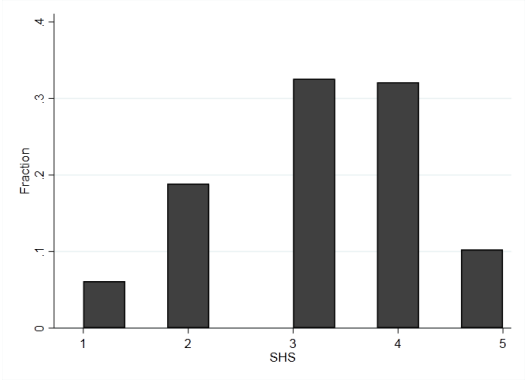
	(1)	(2)	(3)	(4)
Dependent Variable	SHS	SSS	SHS	SSS
Instruments	No	No	Yes	Yes
SHS		0.067***		0.045
		(0.006)		(0.040)
SSS	0.093***		0.024	
	(0.008)		(0.033)	
OHS	0.522***	0.039***	0.419***	0.077***
	(0.006)	(0.006)	(0.016)	(0.022)
OSS	0.136***	0.220***	0.141***	0.066***
	(0.006)	(0.006)	(0.020)	(0.020)
Openness	0.195***	0.684***	0.253***	0.773***
	(0.037)	(0.031)	(0.048)	(0.035)
Conscientiousness	0.429***	0.171***	0.577***	0.299***
	(0.047)	(0.041)	(0.053)	(0.051)
Extraversion	0.410***	0.460***	0.517***	0.411***
	(0.039)	(0.033)	(0.044)	(0.043)
Agreeableness	-0.039	-0.261***	-0.111**	-0.284***
	(0.042)	(0.036)	(0.044)	(0.038)
Neuroticism	-0.506***	-0.431***	-0.667***	-0.514***
	(0.035)	(0.031)	(0.043)	(0.044)
Age/10	0.002	0.076***	0.004	0.114***
	(0.008)	(0.007)	(0.010)	(0.008)
Female	0.152***	-0.017*	0.143***	-0.004
	(0.012)	(0.010)	(0.012)	(0.012)
Immigrate	-0.188***	0.022	-0.178***	-0.058***
	(0.019)	(0.016)	(0.022)	(0.020)
Married	0.004	0.102***	0.043**	0.200***
	(0.012)	(0.011)	(0.019)	(0.015)
Employee	0.095***	0.012	0.158***	0.030**
	(0.013)	(0.011)	(0.015)	(0.014)
Self-employed	0.110***	0.033**	0.171***	0.077***
	(0.020)	(0.016)	(0.022)	(0.019)
Constant	2.325***	2.165***	2.420***	1.877***
	(0.068)	(0.061)	(0.100)	(0.123)
Year effects	YES	YES	YES	YES
Kleibergeen-paap test			0.000	0.000
Hansen test			0.000	0.000
Hausman-Wu test			0.000	0.000
R-squared	0.432	0.259		
Observations	30,675	30,675	30,675	30,675

Note. Univariate linear regressions, without (Columns 1, 2) and with (Columns 3, 4) instruments. The endogenous variables in Column 3 are SSS, OHS and OSS; the endogenous variables in Column 4 are SHS, OHS and OSS. Standard errors clustered at the individual level in round parentheses; p-values in squared parentheses; *** p<0.01, ** p<0.05, * p<0.1.

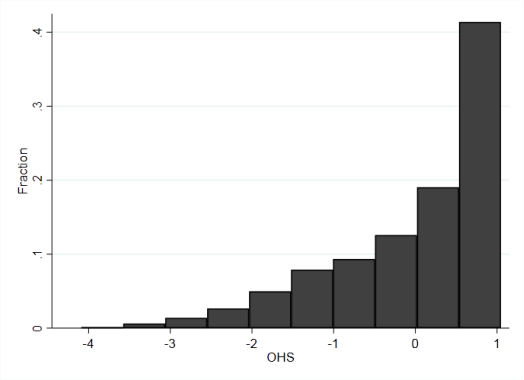
Figure 1. Distribution of objective and subjective measures

a) Health Status

a1) SHS (subjective)

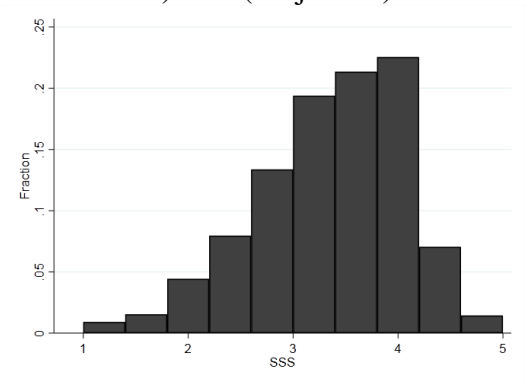


a2) OHS (objective)



b) Socioeconomic Status

b1) SSS (subjective)



b2) OSS (objective)

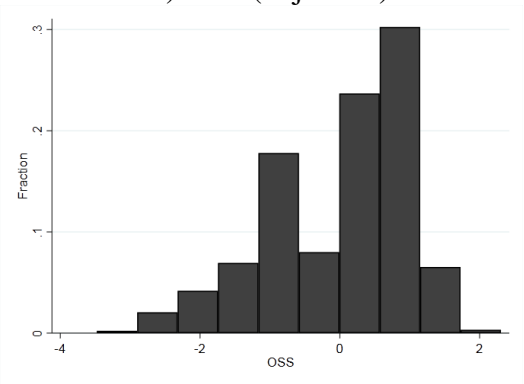
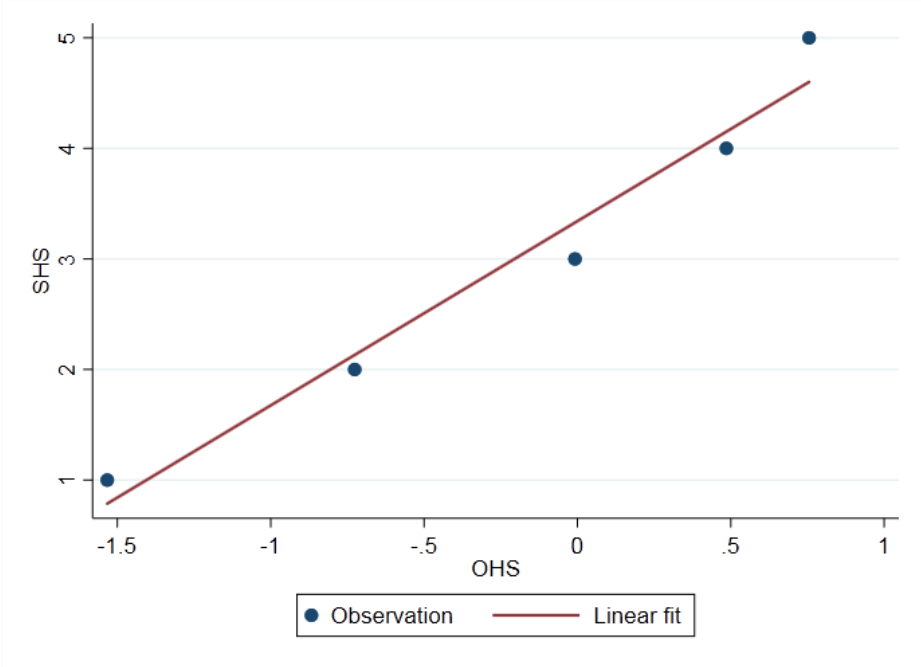
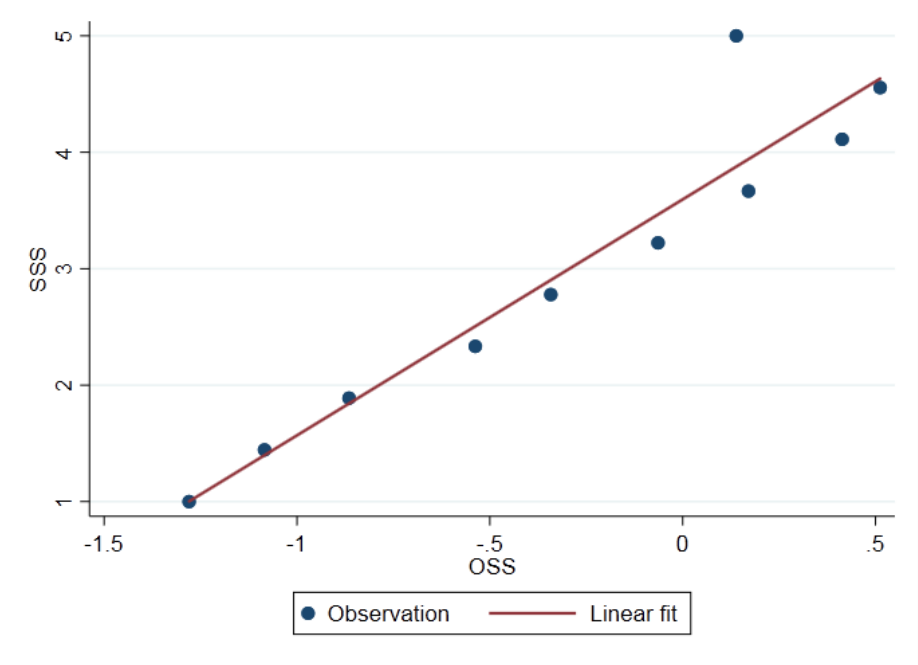


Figure 2. Objective vs. subjective indexes, averages

a) Health status



b) Socioeconomic status



Note. Each point corresponds to the average value conditional on the realization of the subjective measure.

THE SHARED NON-COGNITIVE ROOTS OF HEALTH AND SOCIOECONOMIC STATUS: EVIDENCE FROM THE US

Supplementary Appendix

A. Variable Definitions

A.1. Objective Health Status

The Objective Health Status (OHS) index is derived from a set of raw questions that HRS groups in several categories:

Mobility, strength and motor skill (Nagi scale)

> *"We need to understand difficulties people may have with various activities because of a health or physical problem. Please tell me whether you have any difficulty doing each of the everyday activities that I read to you. Exclude any difficulties that you expect to last less than three months. Because of a health problem do you have any difficulty with ...*
>
> *[G001] walking several blocks*
>
> *[G004] sitting for about two hours*
>
> *[G005] getting up from a chair after sitting for long periods*
>
> *[G006] climbing several flights of stairs without resting*
>
> *[G008] stooping, kneeling, or crouching*
>
> *[G009] reaching or extending your arms above shoulder level*
>
> *[G010] pulling or pushing large objects*
>
> *[G011] lifting or carrying weights*
>
> *[G012] picking up a dime from a table"*

Activities of Daily Living (ADL)

> *"We need to understand difficulties people may have with various activities because of a health or physical problem. Please tell me whether you have any difficulty doing each of the everyday activities that I read to you. Exclude any difficulties that you expect to last less than three months. Because of a health problem do you have any difficulty with ...*
>
> *[G014] dressing*
>
> *[G016] walking across a room*
>
> *[G021] bathing or showering*
>
> *[G023] eating*
>
> *[G025] getting in or out of bed*
>
> *[G030] using the toilet"*

Chronic diseases

"Has a doctor ever told you that you have ...

[C005] high blood pressure or hypertension?

[C010] diabetes or high blood sugar?

[C018] cancer or a malignant tumor, excluding minor skin cancer?

[C030] chronic lung disease such as chronic bronchitis or emphysema?

[C036] heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems?

[C053] stroke?

[C065] emotional, nervous, or psychiatric problems?

[C070] arthritis or rheumatism?"

In addition we consider the following variables:

"[C002] Compared with your health when we talked with you [in the last interview], would you say that your health is better now, about the same, or worse?

[M002] Now I want to ask how your health affects paid work activities. Do you have any impairment or health problem that limits the kind or amount of paid work you can do?

[N099] [In the last two years], have you been a patient in a hospital overnight?

[N114] [In the last two years], have you been a patient overnight in a nursing home, convalescent home, or other long-term health care facility?"

Possible answer for question [C002] are: Better, About the same, and Worse. For all the other variables, possible answers are: Yes; No; Doesn't know; Refuses to answer. For each item we create a dummy variable equal to one if the answer is "Worse" for question [C002] and "Yes" for all the other variables.

Consistently with Poterba et al. (2013) we construct an index of objective health status from a factor analysis on the above variables. Since the variables are qualitative our factor analysis makes use of polychoric correlation; in addition, the analysis allows for cross-year flexibility and is performed separately for each wave. The index turns out to be mostly correlated with the information on mobility, strength and motor skill (Nagi scale) and the information on work limits. Finally, we standardise the OHS index to have mean 0 and variance 1. The higher the index, the better the objective health status.

A.2. Objective Socioeconomic Status

The index is built from a factor analysis with polychoric correlation, computed separately for each wave, on the following variables: education degree (college, high school, lower), income, financial and real wealth. Monetary values are taken in logarithms and converted in 2016 prices using the CPI index from BLS Consumer Price Index, all urban consumers, all items (annual average).

The variables are chosen as in Bucciol et al. (2015) to cover the dimensions that are explicitly stated in the question behind our Subjective Socioeconomic Status (SSS) index. We exclude occupation for two main reasons. First, our sample is mainly made of retirees (44.58% of the respondents). Second, while it is easy to create a ranking for education and money, a job ranking is highly subjective. The index turns out to be mostly correlated with the two variables on wealth (the correlation is 0.90 with financial wealth and 0.77 with real wealth). Finally, we standardise the OSS index to have mean 0 and variance 1. The higher the index, the higher the level of objective socioeconomic status.

A.3. Personality Traits

Personality scores are constructed from the following question:

"Please indicate how well each of the following describes you.
[a] Outgoing
[b] Helpful
[c] Moody
[d] Organized
[e] Friendly
[f] Warm
[g] Worrying
[h] Responsible
[i] Lively
[j] Caring
[k] Nervous
[l] Creative
[m] Hardworking
[n] Imaginative
[o] Softhearted

[p] Calm

[q] Intelligent

[r] Curious

[s] Active

[t] Careless

[u] Broad-minded

[v] Sympathetic

[w] Talkative

[x] Sophisticated

[y] Adventurous

[z] Thorough"

Possible answers to each item are: "A lot", "Some", "A little" and "Not at all", to which we assign the value 4, 3, 2 or 1 respectively. We assign the reverse code to items [p] and [t]. Following Smith et al. (2013), scores are built as the average of the following items:

Openness: [l], [n], [q], [r], [u], [x], [y].
Conscientiousness: [d], [h], [m], [t], [z].
Extraversion: [a], [e], [i], [s], [w].
Agreeableness: [b], [f], [j], [o], [v].
Neuroticism: [c], [g], [k], [p].

Each score is missing when more than half of the underlying items are missing. In the analysis we rescale each index to take values in the 0-1 range.

B. Lewbel Approach for IV Regression

This section describes the Lewbel IV approach (Lewbel, 2012). Let us define X a vector of observed exogenous explanatory variables and $\varepsilon = (\varepsilon_Y, \varepsilon_W)$ two unobserved error processes, possibly correlated with each other. Consider a triangular structural model of the form:

$$Y = X\beta_1 + W\gamma + \varepsilon_Y \quad \text{(B1)}$$

$$W = X\beta_2 + \varepsilon_W . \quad \text{(B2)}$$

For instance, Y may measure subjective health status and W objective health status. The model in Equations (B1)-(B2) tells that both Y and W are described by the same exogenous variables X. However, estimation of Equation (B1) may give rise to biased OLS results because W is an endogenous variable.

A common solution involves using an IV estimator with external instrumental variables. In practice, this means imposing that some parameters in the vector β_1 are equal to zero. That is, some of the exogenous variables in X contribute to describe W but not Y. However, it frequently happens that instruments describing one variable but not the other are not available. A recent contribution in Lewbel (2012) proposes a way to construct instruments directly from the model; the Lewbel IV estimator can then be computed even when external instruments do not exist.

The Lewbel IV estimator is obtained in two steps as follows, exploiting information contained in the heteroskedasticity of ε_W:

1) We run an OLS regression of W on X, obtaining residuals $\hat{\varepsilon}_W$.
2) We run an IV regression of Y on X and W, using as additional instruments $Z = \left(X - \overline{X} \right) \hat{\varepsilon}_W$ where $\overline{X}$ is the sample mean of X.

This estimator is consistent provided that the Z variables satisfy the assumptions required by the IV method to the instruments (i.e., exogeneity and relevance). Baum and Lewbel (2019) report sufficient conditions for having the two assumptions satisfied, that in our context translate into (C1) $Cov\left(X, \varepsilon_Y \varepsilon_W \right) = 0$ and (C2) $Cov\left(X, \varepsilon_W^2 \right) \neq 0$.

Condition C1 is similar to the assumption of exogeneity of the over-identifying restrictions and cannot be properly tested. In this context, the Hansen over-identification test generally rejects the null hypothesis of exogeneity because of the large number of over-identifying restrictions. Condition C2 can be tested using a Breusch-Pagan test on Equation (B.2). The test should reject the null hypothesis of homoskedasticity.

Table B.1 below reports the output of the Breusch-Pagan test on the Lewbel IV models shown in Tables 3-6 of the main text. The test always rejects the null hypothesis, supporting Condition C2 and providing evidence in favor of consistency of the Lewbel IV estimator in our analysis.

Table B.1. Breusch-Pagan test on the heteroskedasticity of the Lewbel instruments

	Table 3	Table 4	Table 5	Table 6
OHS	2,457.46	1,986.31	1,974.83	1,974.83
	[0.000]	[0.000]	[0.000]	[0.000]
OSS		1,163.33	966.58	966.58
		[0.000]	[0.000]	[0.000]
SHS				74.87
				[0.000]
SSS				413.71
				[0.000]

Notes: p-values are in squared parentheses.

References

Baum, C.F., & Lewbel, A., 2019. Advice on using heteroskedasticity-based identification. *Stata Journal*, 19(4), 757-767.

Bucciol, A., Cavasso, B., & Zarri, L. (2015). Social status and personality traits. *Journal of Economic Psychology*, 51, 245-260.

Lewbel, A. (2012). Using heteroschedasticity to identify and estimate mismeasured and endogenous regressor models. *Journal of Business and Economic Statistics*, 30(1), 67-80.

Poterba, J., Venti, S., & Wise, D. A. (2013). Health, education, and the postretirement evolution of household assets. *Journal of Human Capital*, 7(4), 297-339.

Smith, J., Fisher, G., Ryan, L., Clarke, P., House, J., & Weir, D. R. (2013). Psychosocial and lifestyle questionnaire 2006-2010: Documentation report. The HRS Psychosocial Working Group.