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2013

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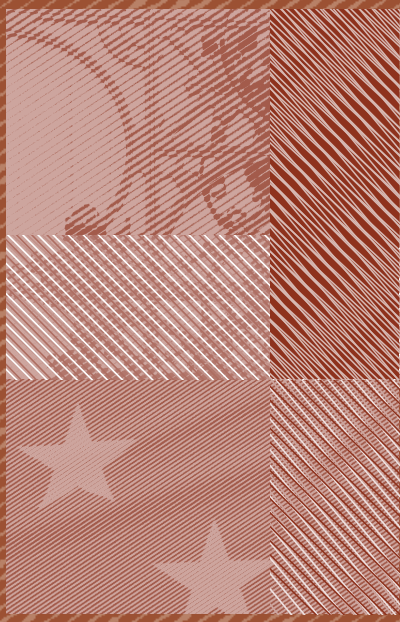

Documentos de Trabajo
N.º 1312

BANCO DE ESPAÑA
Eurosistema

DOES INCOME DEPRIVATION AFFECT PEOPLE'S MENTAL WELL-BEING?

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(*) Maite Blázquez expresses her thanks for the financial support provided by the Spanish Ministry of Education through grant ECO2012-33993, and by the Fundación Ramón Areces (Research Project: Determinants of social exclusion and recommendations for combating it).
(**) Santiago Budría acknowledges the financial support provided by the Spanish Ministry of Education through grant ECO2012-33993 and by the Andalusia regional government through grant P07-SEJ-03261. Part of this research was carried out during Santiago´s research visit to the Banco de España (DG Economics, Statistics, and Research). The author thanks research staff members for their warm hospitality and is grateful to Ernesto Villanueva, Alfonso Sánchez, Samuel Hurtado, Jim Costain, Paloma López-García and Juan Francisco Jimeno for useful comments during and after the seminar. Corresponding author: Santiago Budría, Department of Economics, University of Madeira, Rua Penteada 9000-390, Funchal (Portugal). Phone: +351-291 705 055. Fax: +351-291 705 040. E-mail: sbudria@uma.pt.

Documentos de Trabajo. N.º 1312
2013

ISSN: 1579-8666 (on line)

Abstract

This paper uses panel data from the 2002-2010 waves of the German Socio-Economic Panel dataset (SOEP) to assess the impact of income deprivation upon individual mental well-being. Unobserved heterogeneity is controlled for by means of a random effects model extended to include a Mundlak term and explicit controls for the respondents' personality traits. The paper shows that, for a given household income, a less favourable relative position in the income distribution is associated with lower mental well-being. This effect is not statistically significant among women, though. Among men, a one standard deviation increase in income deprivation is found to be as harmful as a reduction in permanent household income of almost 30%. Interestingly, this impact is found to differ among individuals endowed with different sets of non-cognitive skills. We suggest that policies, practices and initiatives aimed at improving well-being among European citizens require a better understanding of individuals' sensitiveness to others' income.

Keywords: mental health, random effects model, deprivation, personality traits.

JEL Classification: C23, D63, I10, I14.

Resumen

Este trabajo utiliza datos de panel de olas 2002-2010 del Panel Socioeconómico Alemán, a fin de evaluar el impacto que la privación en términos de renta familiar tiene sobre el bienestar mental. La heterogeneidad no observable está controlada a través de un modelo de efectos aleatorios que incluye un término de Mundlak y controles explícitos para la personalidad de los individuos. El artículo muestra que, dada una renta familiar, una posición menos favorable en la posición relativa de la distribución de renta se traduce en un menor bienestar mental. Este efecto no es estadísticamente significativo entre las mujeres. Sin embargo, en el caso de los hombres el efecto perjudicial que un aumento de una desviación estándar en la privación de renta tiene sobre el bienestar mental equivale a un pérdida del 30 % en la renta familiar permanente. Curiosamente, este impacto difiere entre individuos dotados con diferentes habilidades no cognitivas. Estos resultados sugieren que las políticas, prácticas e iniciativas orientadas a mejorar el bienestar de los ciudadanos europeos requieren una mayor consideración de la renta relativa de los individuos.

Palabras clave: salud mental, modelo de efectos aleatorios, privación, personalidad.

Códigos JEL: C23, D63, I10, I14.

1 Introduction

The increasing awareness of the importance of material deprivation and social exclusion is reflected at European level by the “National Action Plans for Social Inclusion”. This programme aims at progressively reducing social inequalities and preventing social exclusion (the Europe 2020 Strategy) and reflects the current need for a multidimensional approach to study social disadvantage. Advancements in the measurement of deprivation and in the analysis of its consequences have been mostly at the aggregate level, with European Member States regularly reporting a set of commonly defined indicators agreed by the European Council.[1]

Somewhat surprisingly, studies at the micro level evaluating the consequences of deprivation on human well-being are scarce. Some evidence stems from the happiness literature, which has largely shown that certain socio-economic factors do affect, in various ways and to different degrees, subjective well-being (SWB). Most of this literature revolves around the income-SWB relationship, with the general finding that a decline in relative income, as measured either by the mean income of the reference group or the individual ordinal ranking within the group, is associated with a decrease in SWB (Clark and Oswald, 1996; Luttmer, 2005; Ferrer-i-Carbonell, 2005; Kingdon and Knight, 2007). This is the so-called "relative income hypothesis". More recent studies have explicitly addressed deprivation issues by developing various indexes for the measurement of the phenomenon (Chakravarty and D’Ambrosio, 2006; Bossert et al., 2007; D’Ambrosio and Frick, 2007) and by differentiating between deprivation in various life domains (Bellani and D’Ambrosio, 2010; Blázquez and Budría, 2012).

Parallel to these advances, studies in the field of health economics have regularly reported meaningful relationships between income, social status and one of the major aspects of an individual’s well-being: health. After controlling for a large set of socio-economic characteristics, including gender, age, educational level and occupation, a strong positive correlation is widely found between good health and absolute income (Subramanian and Kawachi, 2006; Kawachi et al., 2010; and, for a survey of the recent literature using longitudinal data, Gunasekara et al., 2011). This finding gives support to the notion put forward by Grossman (1972) that income gains raise investments in health-enhancing goods. Additional evidence suggests that health outcomes are affected by others' income as well (Wilkinson, 1996; Marmot, 2004). The idea that an individual's health is determined not just by his or her own level of income (in the absolute sense) but also by her income relative to other people lies at the core of the "relative income hypothesis". Even if individuals meet the subsistence standard of living, they may be relatively deprived if they fail to meet the desirable standard of living set by the rest of society. This mechanism has been argued to operate either through material pathways or through psychosocial stress (Lhila and Simon, 2010; Sweet, 2011). On the one hand, failing to “keep up with the Joneses” may lead to inequalities in the access to material goods that have become a social norm, or in the ability to participate in society. On the other hand, interpersonal comparisons may produce frustration and stress, which affect health both directly through a higher propensity to heart disease and high blood pressure, and indirectly via increased smoking, poor eating habits and alcohol abuse (Marmot and Wilkinson, 2001; Marmot, 2003; Jensen and Richter, 2004).

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1. These indicators are aggregate measures of quality of life in different domains, including income inequality, poverty rates, unemployment persistence, health status, life expectancy, education attainment and regional cohesion. Member States “are expected to use at least the primary indicators in their national strategy reports, if only to emphasise that in the context of the EU social inclusion process poverty and social exclusion are a relative concept that encompasses income, access to essential durables, education, health care, adequate housing, distance from the labour market.” (European Commission, 2008, p.16)

In the present paper, we take advantage of the SF-12 questionnaire included in the German Socio-Economic Panel dataset (SOEP), biannually since 2002, to examine how and to what extent deprivation affects mental well-being. The SF-12 is the abridged practical version of the 36-item Short Form Health Survey (SF-36) and was developed as a tool for measuring health-related quality of life. For the sake of consistency with the health economics literature, we will refer to our mental well-being measure as, simply, mental health. The analysis is based on the 2002-2010 waves of the dataset and on an index of deprivation based on the Yitzhaki (1979) index. We present the results of a random effects model that controls for the existence of omitted individual characteristics that might simultaneously influence the dependent and the explanatory variables.

We focus on mental health for several reasons. First, to the extent that physical and mental health outcomes may move in opposite directions, the effect of individual income on an aggregate measure of health is likely to be less precisely estimated (Ruhm, 2001, 2005). For instance, income might significantly improve mental health, but it might have an insignificant effect on general health if higher income leads to unhealthy lifestyle outcomes (Ling, 2009). Second, mental health may represent a pathway through which relative deprivation affects physical health. According to Marmot (2004), individuals at the bottom of the social hierarchy tend to experience higher levels of stress due to their inability to control their lives or to participate fully in all that society has to offer. This low grade chronic stress, acting through the brain, mobilises hormones which affect the cardiovascular and immune systems. In particular, poor mental health has been found to be associated with higher rates of a range of physical illnesses and conditions including heart disease, stroke, diabetes, infectious diseases, and respiratory disorders, as well as with premature mortality (see Sayce and Curran, in Knapp et al, 2007). Third, the prevalence and duration of mental health problems place a considerable burden on health and social care systems. At the European level, the proportion of the health budget devoted to mental health varies considerably from 4% in Portugal to 13% in England and Luxembourg, although definitions and comparability of data require caution (Knapp et al, 2007). The cost of depression alone in the European Economic Area has been estimated at €136.3 billion, of which around one-third falls on the health care system (McDaid et al., 2008). Finally, the importance of mental health has been reflected in the implementation of the European Pact for Mental Health and Well-being[2], which constitutes a statement of commitment from European Member States to a long-term process of exchange, cooperation and coordination on key challenges relating to mental health, contributing to the objectives of the Europe 2020 strategy.

Furthermore, the current context of global economic slowdown has triggered increasing concerns about the well-being of citizens, making the issue of social comparisons and its impact on individuals' mental health an attractive research topic. Firstly, the economic crisis has lead to rising inequality in access to resources, hitting hardest those at the bottom of the social ladder. In 2011, 24.2% of the population in the EU27 were at risk of poverty or social exclusion as compared with 23.4% in 2010 and 23.5% in 2008[3]. Secondly, the proposal for the EU Health for Growth Programme 2014-2020[4] outlines the importance of health for economic growth, emphasising that only a healthy population can achieve its full economic potential. Health is thus not merely seen as a value in itself, but a driver for progress and innovation that plays an important role in the Europe 2020 agenda. The identification, dissemination and

2. European pact for mental health and well-being. EU high-level conference: Together for mental health and wellbeing (Brussels, 2-3 June, 2008).

3. http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/3-03122012-AP/EN/3-03122012-AP-EN.PDF

4. http://ec.europa.eu/health/programme/docs/prop_prog2014_en.pdf

promotion of best practices for cost-effective prevention measures by addressing the “key risk factors” thus become essential for economic stability, security and growth. Improving our knowledge of the determinants of mental health is therefore crucial inasmuch stress and anxiety are considered key risk factors (see McDaid et al., 2008).

An important refinement of our analysis is the inclusion of explicit controls for the respondents’ personality traits. These are extracted from the Big Five Inventory module of personality included in the 2005 wave of the SOEP and a set of complementary questions designed to measure the respondents’ locus of control. This information is used to construct a full set of non-cognitive skills indicators which are then entered as explanatory variables in the random effects health equation. This refinement is important for a number of reasons. Firstly, the case for the use of non-cognitive skills in economics is becoming stronger. There is growing evidence on the relationships between personality and a variety of life outcomes, including health, criminal activity and economic success (for a survey, see Almlund et al., 2011). These effects have led scholars to argue that personality should be given greater consideration in economics (Borghans et al., 2008).

Secondly, a major concern with self-reported data is how to deal with heterogeneity between individuals that is largely considered to be unobservable. Personality, a typically unmeasured source of confounding bias, has emerged in recent years as a predictor of important health outcomes (Hampson and Friedman, 2008). For example, high neuroticism and low conscientiousness are both associated with earlier mortality, whereas a positive attitude towards life and emotional expression are personality phenotypes for centenarians (Kato et al, 2012). Evidence based on long follow-ups shows that the rate of heart-related deaths is substantially lower among optimists than among pessimists due to healthier lifestyles, adaptive behaviours and cognitive responses (Conversano et al., 2010). By contrast, hostility levels are found to be better predictors of heart disease risk than "traditional" factors such as high cholesterol, high blood pressure, smoking, and being overweight (Niaura et al., 2002). Therefore, by including explicit personality controls in the estimating equation, this paper documents and controls for differences in reported mental health between individuals endowed with different sets of non-cognitive skills. A related issue is that the observed correlation between deprivation and health may be not causal if people with certain personality traits are less productive and more deprived and, at the same time, more prone to report bad health. This is likely to be the case, as non-cognitive skills have some predictive power for occupational choices (Judge et al., 1999), employment possibilities (Mohanty, 2010) and earnings (Semykina and Linz, 2007, Mueller and Plug, 2006, Heineck and Anger, 2010). Therefore, by including personality controls we partially factor out from the income and deprivation effect indirect influences flowing from personality to economic status.

Thirdly, fixed effects models can account for the unmeasured time-invariant confounders described so far. However, they preclude the researcher from obtaining reliable estimates on characteristics that have zero or low within-person variation, leaving no room for uncovering improvements to an individual’s health that may simply arise, for example, from being in a permanently high state of deprivation. More importantly, they cannot shed light on the interplay between deprivation and personality, for the latter construct is typically constant over time. By contrast, the inclusion of a full set of non-cognitive skills indicators in a random effects model allows us to test whether non-cognitive skills mediate in the impact that deprivation exerts upon mental health. This research question is central to the present paper. A limitation of earlier studies is the assumption of a deprivation effect that is constant across individuals who, arguably, are endowed with different sets of non-cognitive skills. This simplification is likely to be

unrealistic. Recent evidence points to the relevance of personality in defining the importance of income for SWB (Boyce and Wood, 2011; Proto and Rustichini, 2011) and in determining individuals' capacity to adapt to certain life events such as unemployment (Boyce et al., 2010). Although the role of personality in shaping health sensitiveness to income has never been examined, researchers in the field have acknowledged the importance of controlling for this individual heterogeneity when estimating health equations (Jones and Wildman, 2008). Moreover, meaningful divergences in the relative income effect on SWB between personality groups have been recently detected (Budria and Ferrer-i-Carbonell, 2012). This latter finding is consistent with a corpus of field and laboratory studies in psychology examining the interplay between personality and individual responsiveness to social comparisons (Wood and VanderZee, 1997). Whether non-cognitive skills shape the sensitiveness of mental health to deprivation is a question we answer.

The paper is organised as follows. The next section provides an overview of the literature on the socioeconomic determinants of individual health with special focus on mental health. Particular emphasis is put on the role of societal comparisons. Section 3 describes the data and the measurement of mental health and personality traits. Section 4 formally describes the deprivation index, presents the econometric model and discusses the estimation strategy. Section 5 reports the results and discusses potential problems of reverse causality. Section 6 presents the concluding remarks.

2 Background and previous findings

The relationship between socioeconomic status and health has been widely examined. The evidence is sometimes contradictory, though (see Wildman and Jones, 2008, for a detailed summary). The literature that analyzes the association between individual's income and mental health is also extensive and sometimes conflicting as well. Several studies have found that mental health disorders are highly correlated with low socioeconomic status. Weich et al., (2001) use cross-sectional survey data for Britain to examine the relationship between household income, income inequality and the prevalence of common mental disorders. They show that individuals with the lowest incomes had the worst mental health as measured by the General Health Questionnaire (GHQ). Additionally, a statistically significant interaction is found between income inequality and income level in their associations with the prevalence of mental disorders. In line with Weich et al. (2001), Benzeval and Judge (2001) and Jones and Lopez (2004) also find a significant non-linear relationship between GHQ and income. Clark and Oswald (1994), in contrast, find no significant association between these two variables. In Sturm and Gresenz (2002) both family income and education are strongly related to health, including both mental health disorders and other specific physical conditions[5]. However, no significant association is found between income inequality and depressive disorders or anxiety disorders. Lorant et al., (2003) conducted a meta-analysis of more than 50 cross-national epidemiologic studies on the relationship between socioeconomic status and depression. A lower income is typically associated with a higher risk of depression. Similarly, Fryers et al. (2003) suggests that lower socioeconomic status is associated with increased likelihood of mood disorders, anxiety and substance use disorders. McMillan et al., (2010), in contrast, provide no association between household income and any mood or anxiety disorder for the US. More recently, Sareen et al. (2011) use a large longitudinal population-based mental health survey for the US to examine the relationship between income and mental disorders. They find that individuals with low income were at increased risk for incident mood disorders. Additionally, a reduction in household income was associated with increased risk for mood disorders and substance use disorders, but not with incident anxiety disorders. However, they do not find any evidence to suggest that an increase in household income reduces the risk for incident mental health problems.

The association between income and mental health is, however, suspected to be bidirectional. Poorer mental health may lead to lower income, but lower income may cause poorer mental health as well. Some works have applied instrumental variables (IV) techniques for the purpose of clarifying the causal structure of this relationship. For instance, using both OLS and IV estimates, Ettner (1996) finds that income has a large and highly significant salutary effect on mental[6] and physical health in the US. Potential instruments for family income include the state unemployment rate, work experience, parental education, and spouse characteristics. Based on Swedish longitudinal data, Lindahl (2005) follows an IV approach to provide statistically significant evidence of income causally generating fewer symptoms of poor mental health. Information on individual's monetary lottery prizes is used to create the required exogenous variation in income, an approach suggested by Smith (1999).

5. The measure of mental health includes four psychiatric disorders: major depressive disorder, dysthymic disorder, panic disorder, and generalized anxiety disorder.

6. The measure of mental health incorporates 12 of the 20 items from the Center for Epidemiologic Studies Depression scale, which was created by the National Institute for Mental Health as a community-based screening exam and has been validated by a number of studies (Comstock and Helsing, 1976, Radloff, 1977, Weissman et al., 1977, Ensel, 1986).

In the same line, Gardner and Oswald (2007) use BHPS data to explore the causality running from exogenous variations in income (from medium-sized lottery wins) to changes in mental health, as measured by the GHQ (General Health Questionnaire). They found that positive income shocks lead to better mental health two to three years later. More recently, Apouey and Clark (2009) also use lottery winnings to assess the impact of socioeconomic status on different health measures, including mental stress taken from the GHQ, physical health problems, and health-related behaviors (smoking and drinking). In line with previous findings, their results suggest that greater lottery winnings produce higher GHQ mental health scores.

Another important statistical issue in the health-income relationship is whether there are unobserved, fixed (time-invariant), health relevant respondent characteristics that lead to improved health and that are also related to the explanatory variables. Several attempts in the literature are found to deal with this caveat but very few of them explicitly focus on mental health. One exception is the work of Frijters and Ulker (2008), who use longitudinal data drawn from the US Health and Retirement Study (HRS) between 1992 and 2002. They analyze both the short-run and long-run effects of income on a set of five alternative but clearly related measures of health status, including: i) self-assessed general health; ii) problems with undertaking daily tasks and chores; iii) mental health; iv) body mass index; v) serious long-term health conditions ; and vi) mortality. In addition they apply fixed effects techniques to account for the presence of potential unobserved heterogeneity that creates spurious non-causal relationships between income and health. After controlling for fixed individual traits, they find that a higher income is no longer unambiguously health-improving. For the case of mental health the income effect is still statistically significant but smaller in magnitude. Similarly, Jones and Wildman (2008) use the BHPS and estimate both random and fixed effects models to analyze the impact of both absolute and relative income on GHQ mental health measures. The results are quite mixed and show clear differences between men and women. Increasing income significantly improves mental health for women but not for men even when unobserved heterogeneity is accounted for.

In addition to the direct impact of individual's income on health, a number of indirect mechanisms might also be important determinants of health. These can be due to income inequality, relative deprivation, social capital and other possible pathways (Deaton, 2003). The income inequality hypothesis focuses on the overall distribution of income and suggests that individuals in a society with higher income inequality will have worse health, even if they have the same income as individuals in a more egalitarian society. The argument is that societies with greater income inequality may have patterns of public and private consumption that reduce health (Lynch et al., 2000, 2004). The evidence on mental health is very limited and findings are somewhat inconsistent. Kahn et al. (2000) find that high income inequality is likely to increase the risk of depression especially among those at the bottom of the income distribution. Weich et al., (2001) also provide evidence of inequality related to poor mental health, but only among the wealthier population. Fiscella and Franks (2000), in contrast, report a small association between inequality and mental disorders, while no evidence of such relationship is found in Sturm and Gresenz (2002).

Income inequality however is not the concern of the present paper. In contrast we focus on the impact of social comparisons on individual's mental health. The relative deprivation hypothesis suggests that what matters is the difference between an individual's income and the incomes of individuals in her reference group, rather than the absolute income level. Societal comparisons are important determinants of health through either material pathways or through psychosocial stress (Marmot, 2004, Lhila and Simon, 2010,

Sweet, 2011). On the one hand, the relatively poor may have less access to healthcare or other services if access is rationed or subject to political influence. On the other hand, low relative income may cause stress, anxiety and depression; conditions that may increase the probability of contracting a disease or the tendency to engage in risky behavior such as smoking, heavy alcohol use and a less healthy diet (Marmot and Wilkinson, 2001, Wilkinson, 2001, Marmot, 2003, Jensen and Richter, 2004).

Since the pioneering work of Townsend (1979), a large proportion of papers in the sociological and economics literature have investigated the impact of indirect income effects on health. In particular, the association between relative deprivation and mental health has become a burgeoning topic of interest among many researchers in the field. However, to the best of our knowledge, the existing literature in this area is still scarce. The first study to look specifically at the relationship between relative deprivation and psychological health was Eibner et al., (2004). Using random effects logistic estimations they found that relative deprivation – in the sense of Yitzhaki (1979) – is associated with increased risks of depressive and anxiety disorders and overall poor mental health. Using data extracted from the British Household Panel Jones and Wildman (2008) show that relative deprivation measures, based on Hey and Lambert (1980) and Chakravarty (1990), are associated with mental health disorders for females but not for males. Health outcomes are drawn from the GHQ. In their setting, unobserved heterogeneity is accounted for by using the within individual differences as instruments. More recently, Mangyo and Park (2010) analyze the effect of relative income with respect to relatives and neighbors on two health measures. The first is self-reported health status. The second is an index measure of psychosocial health. Using an econometric approach that controls for both, the unobserved reporting biases affecting both subjective relative income measures and self-reported health, and for the endogeneity of income, they find that higher income is significantly associated with better health. They also find that township mean log per-capita household income negatively affects both health measures after controlling for own income, although the effect is only statistically significant for psychosocial health.

3 Data and measurement

Conducted in Germany since 1984, the SOEP is a wide-ranging representative longitudinal study of households that contains a large set of personal, family and labour market characteristics of household members. The unit of analysis in the present paper are individuals. After dropping observations with missing values in the model covariates, we retain a final sample of 57,826 observations.

Table 1 contains the summary statistics of the sample. Average family income amounts to 2,946€. More than 20.6% of the respondents are aged above 60, while only 7.9% are in the thirties. The resulting average age is 47.3 years. Women account for 51.8% of the sample and the number of adults and children per household is 2.17 and 0.59, respectively. The average educational attainment is about 12.3 years of schooling. Most individuals are employed (71.1%) and married or living with a partner (71.0%). Immigrants account for 7.3% of the sample. In the regression stage of the paper and in order to consider heterogeneous household size and cost-of-life adjustments, all income-based variables were transformed using the OECD equivalence scale and normalized into real terms using the yearly consumer price index.[7] The right part of the table reports the distribution of individuals by German federal states and by years in the estimation sample.

Table 1. Summary statistics

	Mean	SD		Mean	SD
Household income	2946.312	1443.848	Lower Saxony	0.084	0.277
Age < 30	0.079	0.269	Bremen	0.007	0.084
30 ≤ Age < 40	0.221	0.415	N-Rhein-Westfa.	0.203	0.402
40 ≤ Age < 50	0.272	0.445	Hessen	0.068	0.252
50≤ Age < 60	0.222	0.416	R-Pfalz,Saarl.	0.059	0.236
Age > 60	0.206	0.404	Baden-Wuerttemb.	0.123	0.329
Age	47.283	12.150	Bavaria	0.139	0.346
Woman	0.518	0.500	Berlin (East)	0.020	0.140
Years education	12.337	2.698	Mecklenburg-V.	0.028	0.164
No. of children	0.588	0.924	Brandenburg	0.041	0.199
No. of adults	2.167	0.798	Saxony-Anhalt	0.051	0.219
Employed	0.711	0.453	Thueringen	0.046	0.209
Unemployed	0.073	0.260	Saxony	0.072	0.259
Inactive	0.216	0.412			
Married	0.710	0.454	Mental health (MCS)	50.295	9.764
Single	0.171	0.377	Mean/median ratio:	0.979	
Divorced	0.087	0.282	Percentile of the mea	43.90	
Widowed	0.031	0.174			
Foreigner	0.073	0.260	Deprivation	0.241	0.193
2002	0.120	0.325			
2004	0.127	0.333	Conscientiousness	5.896	0.912
2006	0.136	0.343	Neuroticism	3.923	1.227
2008	0.156	0.363	Extraversion	4.864	1.115
2010	0.131	0.337	Agreeableness	5.411	0.955
Berlin west	0.017	0.130	Openness	4.572	1.176
Schleswig-Hols.	0.025	0.157	External LOC	3.545	0.878
Hamburg	0.015	0.120			

7. The OECD equivalized household size, E is defined as follows: let A be the number of household members who are older than 14, and let S be the household size, then E = 1+0.7×(A−1)+0.5(S−A).

3.1 Mental health

Starting in 2002 the SOEP adopted the SF-12 health module that ever since is included every two years. The SF-12 module belongs to the family of health questionnaires based on respondents' self-assessments. As such, it may be subject to criticisms about potential biases arising from framing problems, cognitive bias and mood effects. However, the evidence accumulated over recent years has persuaded most readers about the validity and consistency of self-reported data. Subjectively assessed health has a predictive power over relevant outcomes, is related (in the expected direction) to a number of observable indicators including mortality and longevity (Idler and Kasl, 1995, Idler and Benyamini, 1997, van Doorslaer and Gerdtham, 2003), and is one of the commonest measurement methods used in the literature (Ettner, 1996, Deaton and Paxson, 1999, Smith, 1999, Salas, 2002, Adams et al., 2003, Frijters et al., 2005, Benzeval et al., 2011)[8]. Moreover, there is strong empirical support that subjective evaluations of health predict mortality above and beyond objective health status measures and other known risk factors (DeSalvo, Bioser, Reynolds, He, and Muntner, 2005; Miller and Wolinsky, 2007).

The SF-12 is the abridged practical version of the 36-item Short Form Health Survey (SF-36) that is developed as an applicable instrument for measuring health-related quality of life. The 12 items included in the SF-12 present a Likert scale format and are categorized in eight domains: Bodily Pain (BP), General Health (GH), Vitality (VT), and Social Functioning (SF) with one item each. In addition, Physical Functioning (PF), Mental Health (MH), Role Physical (RP), and Role Emotional (RE) domains are represented with two items each. These domains are the basis of two distinct overall physical and mental health concepts known as Physical Component Summary (PCS) and Mental Component Summary (MCS)[9].

The MCS measure is the object of the present study and we refer to it generically as "mental health". MCS is used widely in the epidemiologic literature and is found to be a reliable and valid indicator of mental illnesses (Salyers et al., 2000). MCS is typically computed by means of explorative factor analysis (PCA, varimax rotation) and transformed to have mean 50 and standard deviation 10[10]. The higher the score, the better the perceived health. All items reflect the current health status of the respondents, as they refer to the four weeks immediately prior to the interview. The appendix provides the details of the SF-12 questionnaire. Table 1 reports the normed mean value of MCS, the percentile in which the mean is located and the mean-to-median ratio. In symmetric distributions, the mean is located in the 50th percentile, so that the mean-to median ratio is one. As the skewness to the left of a variable increases, the location of its mean moves to a lower percentile, and its mean-to-median ratio also decreases. These two statistics show that MCS is skewed to the left.

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8. Some studies use objective measures of health to "purge" self-reported general health measures from reporting error. (Bound et al., 1999, Disney et al., 2006). This type of information is seldom included in large scale micro surveys, though. Nonetheless, it is not clear that objective indicators are not subject to reporting error. In this respect, Baker et al. (2004) matched a wide range of self-reported chronic health conditions to records of public health care usage in Canada, finding clear evidence that such conditions are subject to a large amount of systematic reporting error. See the work of Gupta et al., (2010) for a more detailed explanation on the merits and pitfalls of both subjective and objective measures of health.

9. The SOEP health module is based an updated version of the original questionnaire and is frequently termed the SF-12v2 questionnaire. Still, the SOEP version deviates from the standard SF-12v2 to some degree in the formulation, order and wording of questions.

10. See Andersen et al. (2007) for a SOEP-based technical description of the algorithm used to compute the MCS score and the psychometric properties and factor structure of the SF-12v2.

3.2 Non-cognitive skills

In 2005 the SOEP includes a set of questions aimed at capturing various measures of personality: a short version of the Big Five Inventory (BFI), and a set of questions to assess the degree of external or internal Locus of Control (LOC).

The Big Five and the LOC measures are two alternative well known ways to describe individuals' non-cognitive skills. LOC aims at capturing the degree to which individuals believe that the course of their life is under their control or depends on external circumstances, such as luck or social conditions. The BFI is a well-accepted measure to describe the five major traits that define human personality across cultures (Costa and McCrae, 1992): openness, conscientiousness, extraversion; agreeableness, and neuroticism. Neuroticism is the tendency to experience negative emotions such as anxiety and depression; extraversion is the tendency to be sociable, warm, active, assertive, cheerful, and in search of stimulation; openness to experience is the tendency to be imaginative, creative, unconventional, emotionally and artistically sensitive; agreeableness reflects a dimension of interpersonal relations and is characterized by altruism, trust, modesty, and cooperativeness; and conscientiousness is the tendency to be organized, strong-willed, persistent, reliable, and a follower of rules and ethical principles.

The BFI questionnaire used in the German SOEP is based on 3 items for each personality dimension, which makes a total of 15 items. Despite psychologists typically work with longer questionnaires, the shortened version introduced in the German SOEP and used in this paper, known as the BFI-S, has been validated against longer inventories. The 15 BFI-S items are:

I see myself as someone who: (i) worries a lot, (ii) gets nervous easily, (iii) is relaxed, handles stress well, (iv) is communicative, talkative, (v) is outgoing, sociable, (vi) is reserved, (vii) is original, comes up with new ideas, (viii) values artistic experiences, (ix) has an active imagination, (x) is sometimes somewhat rude to others, (xi) has a forgiving nature, (xii) is considerate and kind to others, (xiii) does a thorough job, (xiv) does things effectively and efficiently, and (xv) tends to be lazy.

The first three items aim at capturing neuroticism; the second set relate to extraversion, followed by openness to experience, agreeableness, and the last 3 items relate to conscientiousness. Respondents can cast their answers on a 1 to 7 scale, where 1 stands for "does not apply to me at all" and 7 for "applies to me perfectly". Some items are reversely scored, i.e., a higher score negatively correlates with the dimension under evaluation. The measure used in the regression analysis for each of the five personality traits is an average across the three items. Therefore the personality measures used in the empirical analysis can range from 1 to 7. This is standard in the literature, as the BFI was designed so as to generate a single measure for each of the five different personality traits. An important issue in personality measures is the concern that variability in the resulting scores arise from measurement error. In our data, encompassing tests of internal consistency were satisfactory[11].

11. A principal component analysis with varimax rotation was conducted. Factor analyses clearly replicated the Big Five factors by yielding a correlation matrix with five eigenvalues above unity. The five principal components accounted for 60.7% of the total variance. The Cronbach's alphas for the five dimensions were 0.607, 0.657, 0.625, 0.505 and 0.609, respectively. It must be noticed that for a given level of internal consistency, fewer items per dimension result into lower alphas (Mueller and Plug, 2006). Hence, although these reliability coefficients are towards the lower range of admissible values, they point to a reasonable amount of internal consistency given the low (3) number of items per personality traits.

LOC is a measure of the degree to which individuals feel the control of their life is on their own hands (internal) or depends on external factors (external). People with a high score in the items measuring external LOC believe that fate, luck, social conditions, or any other external circumstances are important determinants of the course of their lives; while those with a high score on internal LOC perceive that their life depend on own behaviour and efforts. LOC has become an important concept to define personality within psychology. Lockwood (2002) found that the extent to which one finds social comparisons inspiring or threatening depends on whether one finds a sense of control over the dimension under evaluation. In the SOEP data, LOC is surveyed with 10 items: the first four relate to internal LOC and the other six are aimed to measure external LOC. These are:

(i) My life course depends on me, (ii) influence on social conditions through involvement, (iii) success takes hard work, (iv) doubt my abilities when problems arise, (v) haven't achieved what I deserve, (vi) what you achieve depends on luck, (vii) others make the crucial decisions in my life, (viii) possibilities are defined by social conditions, (ix) abilities are more important than effort, (x) little control over my life.

Unfortunately, internal LOC was found to exhibit a very limited amount of construct validity in the data[12], meaning that the surveyed items are not at all appropriate for measuring the underlying scale. This forced us to exclude internal LOC from the analyses and focus exclusively on external LOC, i.e. the last six items. The respondents are asked to answer each item on a 1 to 7 scale, where 1 stands for "disagree completely" and 7 for "agree completely". The measure used in the empirical analysis is also an average over the six items and can thus take values 1 to 7. A high score indicates that individuals have an external LOC, i.e., they feel that their life is largely driven by external factors such as luck and social conditions.

Table 1 shows the sample averages for each of the six personality measures. In the regressions stage of the paper, these were normalized to a mean zero and unit variance.

3.2.1 THE STABILITY OF NON-COGNITIVE SKILLS

The different measures of personality were gathered only in the 2005 wave of the German SOEP[13]. To deal with this limitation, we relax the often imposed assumption that these constructs are constant over the period of analysis. We do that even though the time persistence of personality should not be seen as a stringent assumption, as it is generally accepted that adult's personality traits are fairly stable over time (Roberts and Del Vecchio, 2000, Costa and McCrae, 2002). In our sample, the respondents mean age is 47.3 years and on average they are interviewed during no more than 9 consecutive years, so that the potential interdependency between early life events and personality should not play much of a role. Still, some concerns may persist under the light of recent studies pointing to changes in personality traits over the life cycle and following changes in one's social and job environment. Aging is the most prominent factor put forward in those studies, with people steadily becoming more agreeable, conscientious and less neurotic over the life cycle (Roberts et al., 2006, Soto et al., 2011). Environmental factors and major life events, including marriage, divorce, widowhood, and transitions into an out of employment, may also affect personality (Specht et al., 2011, Kandler et al., 2012).

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12. The alpha reliability coefficient was as low as 0.201.

13. These were again partially surveyed in the 2009 and 2010 waves. However, we stick to the 2005 information. This choice reduces the time gap between the measurement of personality and the observational period, for 2005 is more centered within the sampling interval (2002-2010).

To address these concerns, in this paper we regress each personality trait on age and age squared, labour market status (employed, unemployed, reference: inactive) and marital condition (single, divorce, widowed, reference: married). The predicted residuals are free from this specific life events and, therefore, used as the relevant measures of personality. Expanding the set of regressors to include additional variables such as income, health and region or, alternatively, using the raw measures of personality lead to very similar results.

4 Method of analysis

4.1 Definition of reference group

The determination of the relevant reference group and the reference outcome for a given class of individuals is ultimately an empirical question. The social context, the saliency of particular agents and the social proximity among individuals are all likely to influence reference groups and outcomes. As large-scale surveys typically do not contain direct questions about the composition of reference groups, researchers in the field usually have to decide by themselves how to identify a relevant group. While some authors rely on a pure geographical approach whereby comparisons take place among people living in the same geographical area (Di Tella et al., 2003, Blanchflower and Oswald, 2004, Luttmer, 2005) some others identify comparable socio-demographic groups according to gender, age and education (Boyce et al., 2010, Ferrer-i-Carbonell, 2005) or even race (Eibner and Evans, 2005, and Subramanian et al., 2009).

This paper follows a mixed approach by constructing reference groups taking into account some individual characteristics as well as introducing a geographical dimension into the analysis. In concrete, we generate reference groups by partitioning the sample into various groups using the geographical region where the household lives (West or East Germany), the gender and the education attainment of the respondent (less than 10, 10-10.5, 11-11.5, 12 and more than 12 years of schooling), and the age of the respondent (younger than 25, 25-34, 35-44 and older than 65). The combination of these criteria produces 100 different groups. To ensure the maximum representativity of these, the SOEP data were filtered using a two-stage procedure. The first stage consists in retaining individuals with non-missing information for income and the four demographic dimensions used to define the reference groups. This rendered a total of 92,353 person-year observations. The average number of individuals in a group ranged from a minimum of 10 to a maximum of 728 with an average of 306.8 (SD = 170.4)[14]. Then, observations with missing values in the model covariates are dropped, which yields the final sample of 57,826 observations described in Section 3.

While the reference group is defined at the individual level, income is taken at the household level. Individuals are assumed to obtain information about the others through their own reference group, i.e., we assume that individuals generate information by looking at those similar to them. Nevertheless, since we examine the effect of income deprivation on MCS and we know that individuals generate health from their disposable income, we take household (and not personal) income as the relevant measure. This implies to assume that, at least to a large extent, there is income pooling at the household level. In sum, individuals are assumed to compare themselves with (and thus to have information on) the household income level of individuals like them.

4.2 Income deprivation

We use income as the object of relative comparisons. The Yitzhaki index (Yitzhaki, 1979), derived from Runciman's theory has been commonly used as a measure of relative deprivation, capturing the expected income difference between an individual and others in his

14. Although sensitive analysis showed that it did not affect our results, we dropped those individuals in a group with less than 10 observations in a given year. 102 observations were affected by this choice.

or her reference group that are more affluent. Formally, for a person i with income y_i who is part of a reference group of size n, the Yitzhaki index is given by:

$$d_i(y) = \frac{\sum_{j \in B_i(y)} (y_j - y_i)}{n} \text{ if } B_i(y) \neq 0 \qquad (1)$$

where $B_i(y) = \{j \in n | y_j > y_i\}$ is the set of individuals whose income is higher than that of individual *i*. In this paper we follow D'Ambrosio and Frick (2007) and use a refinement of the Yitzhaki index capturing the gaps between the individual's income and the incomes of all individuals richer than him, as a proportion of mean income.

In particular, let $\mathbb{D}^n$ denote the set of income distributions for the population or the reference group, if different from the whole population. An income distribution is a vector $y = (y_1, \ldots, y_n)$, and the set of all possible income distribution is $\mathbb{D} = \cup_{n \in \mathbb{N}} \mathbb{D}^n$, where $\mathbb{N}$ is the set of positive integers. Then for all $n \in \mathbb{N}$, $y \in \mathbb{D}^n$, we define the mean of y as $\lambda(y)$, and the illfare ranked permutation of y *is* $\bar{y} = (\bar{y}_1, \ldots, \bar{y}_n)$, that is $\bar{y}_1 \leq \cdots, \leq \bar{y}_n$ (see D'Ambrosio and Frick, 2007, pp. 499). Thus, the deprivation function for a person with income y_i is given by:

$$D_i(y) = \frac{\sum_{j \in B_i(y)} (\bar{y}_j - \bar{y}_i)}{n} \text{ if } B_i(y) \neq 0 \qquad (2)$$

And the relative deprivation function of that person would be:

$$D^r{}_i(y) = \frac{\sum_{j \in B_i(y)} (\bar{y}_j - \bar{y}_i)}{n\lambda(y)} \text{ if } B_i(y) \neq 0 \qquad (3)$$

4.3 Specification and research hypotheses

We assume that MCS is a function of demographic characteristics (*X*), income (*y*), income deprivation (*d*) and the respondents' set of non-cognitive skills (NC), the underlying assumption being that personality is an important component of individual heterogeneity in health equations

$$MCS = f(MCS^*(X, y, d, NC)). \qquad (4)$$

The empirical analysis will be based on two different specifications of Eq. (4). Specification 1 assumes that the different non-cognitive skills groups respond uniformly to changes in deprivation levels. With this specification non-cognitive skills exert a level effect on MCS but do not mediate in the relationship between MCS and income deprivation. Specification 2 allows for a full set of interaction terms between deprivation *d* and vector *NC*. We hypothesize that non-cognitive skills mediate the impact of income deprivation upon MCS. Finally, there is evidence that socioeconomic gradients in health may be driven by gender (see Contoyannis et al., 2004). Thus, we carry out separate estimations for males and females.

Despite MCS is a function of ordinal variables, we take MCS to be more nearly cardinal. While this assumption is typically unimportant for the significance and relative effect of the explanatory variables (Ferrer-i-Carbonell and Frijters, 2004), it has the advantage of yielding coefficients that can be directly interpreted as marginal effects. The resulting (linear) model is:

$$MCS_{it} = \alpha X_{it} + \beta_p \bar{y}_i + \beta_s \Delta y_{it} + \gamma NC_{it} + \delta d_{it} + v_i + \eta_{it} \qquad (5)$$

where ν_i is a time-invariant effect and η_{it} is an independent error term. $\bar{y}_i$ stands for the average of y_{it} over the T years in the panel. Since $\beta_p\bar{y}_i + \beta_s y_{it} = (\beta_p + \beta_s)\bar{y}_i + \beta_s \Delta y_{it}$, this refinement allows us to assess how changes in household income affect MCS depending on whether they are permanent $(\beta_p + \beta_s)$ or transitory (β_s). X includes years of completed education, household size (number of children and number of adults at home) and additional dummy variables for age, gender, employment status, marital condition, nationality, region and year fixed effects. Income is entered in its logarithmic form to account for a non-linear relationship.

An implicit assumption of random effects models is that the random component ν_i is uncorrelated with the explanatory variables. This may be seen as a rather strong assumption insofar as the dependent as well as the right-hand side variables may be driven by omitted characteristics. Thus, for example, healthier individuals may be more likely to marry and form larger households and be more successful in life. The Mundlak term is intended to control for such correlations and consists of a vector $\bar{X}_i^M$ with the time-averaged values of a subset of M explanatory variables. With this strategy the unobserved heterogeneity of the standard RE model is assumed to consist of two parts, $\nu_i = u_i + \lambda\bar{X}_i^M$. The first part is a pure error term. The second part is assumed to vary linearly with the within-group means, whereby a possible correlation between the independent variables and the idiosyncratic characteristics is accounted for. Thus, Eq. (5) becomes:

$$MCS_{it} = \alpha X_{it} + \beta_p\bar{y}_i + \beta_s\Delta y_{it} + \gamma NC_{it} + \delta d_{it} + \lambda\bar{X}_i^M + u_i + \eta_{it} \qquad (6)$$

with $u_i \sim N(0, \sigma_u^2)$, $\eta_{it} \sim N(0,1)$, $Cov(u_i, \eta_{it}) = 0$. The Mundlak variables were chosen to be: proportion of years in the panel during which the individual is unemployed, proportion of years during which the individual is inactive, (individual) time averaged value of years of schooling, number of children at home and number of adults[15].

15. We call attention to the average income level $\bar{y}_i$ included in the regression, which can be regarded as part of the Mundlak term. However, for expositional purposes, we prefer to maintain a separate notation.

5 Results

Table 2 reports results from specifications 1 and 2 discriminated by gender. All standard errors in the paper are corrected for clustered error terms at the reference group level[16]. The assessment of the statistical significance of the effects reported in the paper might be regarded as conservative, as clustering at the individual level resulted in approximately 30% lower standard errors. Results excluding East Germany presented little variations and are available from the authors upon request.

As expected, income is positively associated with MCS. The first row reports the marginal effect of transitory increases in income, whereas the permanent component of the income variable is captured in the second row. Among men, permanent income is a more important source of mental health than transitory income, while the opposite applies to women. Under specification 1, a 1-unit increase in logarithmic permanent income (a 171.8% increase in absolute levels) raises MCS by 0.779+0.853 = 1.632 score points among men and by 1.496 +1.232 = 2.728 points among women. In spite of being neatly significant, these figures might be regarded as small. However, it should not be so if we take into account their distributional effects. A reference man will see his position in the MCS distribution improved by 6.1 percentiles (from the 42.4^{th} to the 48.5^{th} percentile) following a 1-unit increase in permanent income, while the upward shift amounts to 12.8 percentiles in the women's distribution (from the 44.5^{th} to the 54.3^{th} percentile). These figures are ceteris paribus, i.e., holding income deprivation constant. This would occur if every income in the reference group were increased by some multiplicative constant.

Turning to the crux of our analysis, we find that income deprivation exerts a negative, statistically significant effect upon men's MCS. The estimates are ceteris paribus (i.e., for a given household income), an observation that suggests that at least among men the detrimental effects of low income are partly driven by adverse social comparison information. A relevant question is: how much extra income would have to be given to the person to compensate exactly for a sudden increase in his deprivation level? In the male sample, a switch from average to a one standard deviation-above average deprivation level decreases MCS by 0.575 score points (a 2.8 percentile downward shift in the male MCS distribution). According to the estimates, such variation of the individual's relative position is as important as a 0.738 units decrease in log transitory income or, in other words, a reduction down to exp(-0.738)*100 = 47.8% of the initial income. This figure is exp(-0.352) *100 = 70.3% if we take permanent income as comparison benchmark.

By contrast, deprivation fails to attract a significant coefficient among women. This result is consistent with the evidence reported by Jones and Wildman (2008) who, using BHPS panel data, find that women's general health is less responsive to societal comparisons than men's. Although it is difficult to advance a convincing explanation, it is possible that among women it is income itself which is acting as the status variable. The substantially larger effect of both permanent and transitory income found in our female sample relative to the male sample gives partial support to this explanation.

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16. Angrist and Pischke (2008) show that group-level clustering can produce biased standard errors if the number of groups is low (<40). This is not the case in our estimations, which are based on 100 population groups. Block bootstrapping, which consists on drawing blocks of data defined at the reference group level and then computing standard deviations from the different subsamples (Cameron and Trivedi, 2010), produced similar results.

The impact of the remaining variables is as follows. Mental health is lowest during middle adulthood, with the 40-60 age groups reporting significantly lower MCS levels than individuals in the youngest (< 30) and reference (age > 60) groups. Schooling is largely innocuous among men, whereas more educated women report significantly higher levels of MCS. A similar finding applies to the number of children at home, a variable to which women are responsive. A related finding is that men in larger households (as measured by the number of adults at home) report significantly lower levels of MCS. Employment status plays an important role. Unemployed and inactive individuals report significantly lower MCS levels. Whereas the former effect is slightly lower among men, the later is sensitively higher. The estimates are sizable relative to the impact of other covariates. Thus, for example, among men the effect of unemployment upon MCS (-0.858) is roughly as large as the 0.779 figure found for a 2.7 factor increase (a 1-unit increase in the logarithm) in transitory income. In other words, the influence of employment status on MCS flows through mechanisms other than income, a result that is consistent with previous work pointing to harmful effects of unemployment upon individual well-being (Powdthavee, 2012). Singleton men report higher MCS, whereas the divorced and the widowed are as healthy as the reference individual (married). Among women, marital status is not significantly related to MCS scores. Finally, immigrant men report higher MCS scores.

Next we move on to the role of non-cognitive skills. MCS depends positively on conscientiousness, extraversion and agreeableness, and negatively on neuroticism and external LOC. More open-to-experiences women tend to report higher mental health. The figure for neuroticism is quiet impressive. Neuroticism is the tendency toward hand wringing and negative thinking and people with a heavy dose of neuroticism are known to be more stressed, anxious and moody. The results seem to support this intuition. A one standard deviation increase in neuroticism has an effect of about -2.53 score points on MCS, the figure of this specific trait being lager and of opposite sign than the joint effect of a simultaneous increase in conscientiousness, extraversion and agreeableness. The coefficient of external LOC shows that MCS is lower among individuals who believe that fate, luck or other external circumstances are the leading force behind human fate. All in all, the strong association between personality traits and health is consistent with earlier clinical studies in the field of psychology. Results based on large US national samples over long follow-ups show that Big Five traits predict various health outcomes, including self-rated health and that this association is strongest for conscientiousness and neuroticism (Turiano et al., 2012). In our data, a F-test for the BFI and LOC measures shows that these constructs are jointly significant in determining MCS (p-value = 0.000), with conscientiousness and neuroticism exhibiting the largest effects upon MCS.

Although the pathways through which personality could affect mental health are complex, some hints may be advanced. An important channel is divergent health behaviours and attitudes adopted by individuals with different traits. Although the causal relations are multifaceted and involve genetic underpinnings, the evidence suggests that conscientious people (e.g., persons who tend to be organized, responsible, and disciplined) smoke less, eat healthier foods, wear seat belts, practice more sports and engage in a range of other healthy behaviours (Hampson et al. 2006, Roberts et al. 2007). Probably as a consequence, conscientiousness is negatively associated with various health problems (e.g., diabetes, hypertension, urinary problems, stroke and a variety of mental illnesses) and predicts health and longevity in various populations and over long periods of time (Roberts et al., 2007, Kern and Friedman, 2008, for a meta-analysis, Bogg and Roberts, 2004). Neuroticism, or negative emotionality, also has clear associations with both health behaviors and health outcomes.

Neuroticism is related to the exposure people have to stressors but also in their reaction (or overreaction) to stress (Bolger and Schilling, 1991, Kling et al., 2003, Mroczek and Almeida, 2004). Similarly, having worrying tendencies or being the kind of person who stresses easily is found to lead to bad behaviours like smoking and, therefore, raises the mortality rate (Mroczek et al., 2009).

The coefficients of extraversion and LOC can be well understood if we examine behavioural attitudes among individuals who score high on these particular traits. External individuals are known to undertake less health enhancing behaviours, take less interest in health messages and take fewer steps to control their health status (Strickland, 1989), whereas people who are outgoing, involved in their communities, and with strong social connections reap health benefits and exhibit improved coping skills (Holt-Lunstad et al., 2010).

5.1 Do non-cognitive skills mediate in the effect of income deprivation on MCS?

Specification 2 asks whether individuals with different sets of non-cognitive skills have different MCS reactions to changes in deprivation levels. For example, do individuals that score high on neuroticism overreact to changes in their deprivation level relative to individuals that score low on neuroticism? Are conscientious individuals more adversely affected by a decline in their relative position? To test such hypotheses, the personality measures are interacted with the household income variable. The estimates, reported in the last two columns of Table 2, are suggestive of a non-negligible amount of heterogeneity across personality groups.

There is strong evidence that neurotic people experience larger health drops from rises to their deprivation level. Among men, the detrimental effects of deprivation on MCS rise by 0.215 additional points if the individual scores one standard deviation above the sample average level of neuroticism. This is quite an increase, for it represents a 34.0% variation relative to the average deprivation effect (-0.632). Therefore, holding everything else constant, a typical man would need to be (0.215+0.870)/0.870 = 1.25 times more deprived than someone with one-standard deviation of extra neuroticism to reach the same level of MCS. Women are on average quite unresponsive to social comparison information, at least when it comes to income comparisons. However, those scoring high on neuroticism do react negatively when confronted with unfavourable comparison information (-0.160).

The remaining interaction terms document additional divergences across personality groups. Extroverted and open-to-experiences men undergo additional health loses following rises in their individual deprivation. Relative to the typical individual, a one standard deviation shot in these traits raises the deprivation effect by 22.5% and 29.7%, respectively. Such divergences are gender specific, though. Among women, only conscientiousness is found to enlarge the negative effects of deprivation on MCS. Finally, the estimates suggest that agreeableness and external LOC, both among men and women, do not mediate in the MCS-deprivation relationship.

5.2 Reverse causality

The results so far do not tell everything of the causal effect of deprivation on health. It is likely that health and socioeconomic status – especially income – are linked through a bi-directional relationship (see Smith, 1999, and Adams et al., 2003 for a broad review). Income, through the acquisition of goods and services affects health (Marmot, 2003, Rablen and Oswald, 2008). However, good health is an income-producing factor (Ettner, 1996). There are two main sources of potential confounding bias: an individual time-invariant component

correlated with the left and right hand side variables and, second, an individual time-varying component. As for the first concern, the Mundlak correction term takes account of unobserved factors that may be correlated with MCS and the explanatory variables (education, household size, labour status). If residually healthier individuals (i.e., individuals with higher MCS conditional on the vector of explanatory variables) are more likely to be employed and complete a higher level of education, the Mundlak term corrects for this. In this respect the Mundlak term takes account of the possible endogenous determination of MCS and deprivation. The second refinement is the introduction of explicit measures of the respondent's personality traits. There might be some reverse causation, with a better health status leading to higher future incomes. But to the extent that a better health stems from personality-related risk attitudes and preventive health behaviour, this reverse causality is controlled for in our estimation.

However, we cannot totally account for time-variant changes in deprivation levels caused by health changes. A healthier person could work longer hours, take fewer sick leaves and have greater productivity, thus leading to lower deprivation. Reversely, bad health increases the probability of job loss (Riphahn, 1996). One solution to this endogeneity problem could be an instrumental variable approach[17]. However, in practice, it is very hard to find relevant and valid instruments, i.e., variables that correlate well with income and deprivation but not with MCS. Any of the candidate variables available in the SOEP are also likely to have direct effects on MCS beyond those flowing indirectly through income. This problem may yield biased estimates and will be exacerbated by a weak correlation between the endogenous variable and the instruments (Bound et al., 1995). An additional problem is that the high correlation between income and deprivation (0.88 in our data) prevents the identification of separate income and deprivation effects.

To address these concerns, in Tables 3 and 4 we present estimates for different population groups. The first sub-sample is composed by individuals who worked constantly between 2002 and 2010 and, thus, disregards all individuals who ever experienced an unemployment spell or were out of the labour force. This restriction rules out the possibility that financial troubles and mental health declines are a consequence of job loss. Another possible pathway of worse health due to financial problems is the loss of the household breadwinner, the associated funeral costs and other changes in family arrangements, including household split-ups. To block this channel, the second sub-sample comprises respondents that were always married. The third set of results focuses on individuals who during all years in the sample reported savings amounts above the median ('savers'). This restriction puts off the estimations respondents whose mental health deterioration was the onset of a period of reduced income, increasing debt burdens and additional deprivation.

The results in Table 3 seem to suggest that none of these channels are the driving force behind the observed deprivation effect. The estimates are broadly supportive of the earlier findings. Women are responsive to changes in permanent and transitory income but unresponsive to comparison information. Conversely, in all sub-samples deprivation exerts a negative, statistically significant effect upon men's MCS. Among savers and married individuals the estimate (-0.910 and -0734, respectively) is even larger than in the total sample

17. Indeed a number of methods have been applied in the literature to deal with the reverse causality in the socioeconomic status-health relationship: (i) limiting the investigation to individuals with an initially good health state (Lynch et al., 1997); (ii) disaggregating the sample to individuals with different levels of health (Fuchs, 2004); (iii) estimating fixed effect models (Winkelmann and Winkelmann, 1998); and (iv) using an instrumental variables approach (Ettner, 1996; Lindahl, 2005; Theodossiou and Zangelidis, 2009; Economou and Theodossiou, 2011).

(-0.575). Table 4 supports the notion that individuals with different sets of non-cognitive skills have different MCS reactions to changes in deprivation levels. Like in the benchmark specification, we find that open-to-experiences men are more deprivation-sensitive, while neurotic individuals tend also to react more negatively to comparison information. Relative to the benchmark results we detect some variations, though. Neuroticism does not significantly alter the MCS-deprivation relationship among the savers, both men and women, nor among married women. Similarly, in all male subsamples the interaction term with extraversion fails to be the statistical significant, an observation that is at odds with the results from the full sample. All in all, these variations suggest that to some extent the interplay between personality and deprivation may be group-specific.

The last columns of the tables test for another possible pathway of worse health due to income problems by examining the relationship between lagged deprivation and MCS. This exercise admits the possibility that it takes time for mental health to respond to changes in individual deprivation and, at the same time, rules out the possibility of contemporaneous reverse causality. We find that lagged deprivation significantly decreases MCS among men. Even though the coefficient is practically halved when we switch from contemporaneous to lagged deprivation, this observation is suggestive of a causal effect running from deprivation to health and not the other way round. The results in the female sample give further support to this hypothesis: in a model that rules out the possibility of contemporaneous reverse causality, we find that (lagged) deprivation is a large, negative determinant of women's MCS. Interestingly, the results are suggestive of even larger differences between personality groups. Among men, the detrimental effects of deprivation on MCS rise by 0.349 additional points if the individual scores one standard deviation above the sample average level of openness. This represents a remarkable 2.2 factor increase relative to the average effect. Among women the variation amounts to a non-negligible 1.6 factor increase. Similarly the deprivation effect boosts, by between 40% and 60%, among neurotic men and external LOC women.

6 Conclusions

This paper used the SF-12 questionnaire included in the German Socio-Economic Panel dataset (SOEP) to examine the impact of deprivation upon an important source of well-being: mental health. Income comparisons are found to play a significant role in determining mental health among males. The evidence among females, however, is not so conclusive. Among men, a one-standard deviation increase in income deprivation was found to be as harmful as a reduction in permanent household income of about 30%. This is sensitiveness to other people's income on a large scale. This figure was slightly above 50% when we considered transitory income. Among women the effect of both the transitory and permanent components of own income on mental health was larger than for men. These results suggest that practices and initiatives aimed at improving the well-being of European citizens would require a better understanding of individuals' sensitiveness to others' income.

An important refinement of the analysis was the inclusion of explicit controls for the respondents' non-cognitive skills. These were extracted from the Big Five Inventory module of personality included in the 2005 wave of the SOEP and a set of complementary questions aimed to measure the respondents' locus of control. Thus, the paper goes beyond the common simplifying assumption in the literature that the health gradient is constant across individuals endowed with (typically unobserved) different sets of non-cognitive skills. According to the results, these skills play a crucial role in forming the impact of income deprivation on mental health.

Tackling the social determinants of mental well-being will have benefits at both the individual and the aggregate level. Firstly, to the extent that health outcomes are vital for a satisfying life, reducing socioeconomic inequalities in health is likely to result in increased individual well-being (van Praag and Ferrer-i-Carbonell, 2004; Veenhoven, 2008). Secondly, health improvements are beneficial to economic growth (van Zon and Muysken, 2001; Bloom et al., 2004; Gourdel et al., 2004). The current context of economic recession has prompted increasing concern about this issue. In recent years, mental health problems have affected a growing share of European citizens and have emerged as a growing source of productivity loss, since they are an increasingly important cause of sick leave, disability benefits and early retirement due to mental disorders (Alonso et al., 2004).

Mental health has been shown to be one of the major risk factors for suicide, and suicide rates have been rising in the EU since 2008, when the euro area entered a recession. A recent paper in *The Lancet* reported that suicide rates have risen most in the countries hit by the most severe financial reversals of fortune (Stuckler et al., 2011). The most dramatic change was in Greece, where the number of suicides rose 19 percent. The Greek Ministry of Health reported that suicides jumped 40 percent in the first half of 2011 compared with the same period in 2010. In a single year, the rate increased from 2.8 suicides for every 100,000 people to at least five per 100,000. These figures illustrate well the harshness and detrimental effects of the current economic crisis. By documenting the importance of income comparisons in determining individuals' mental health, the present paper attempts to provide useful guidance for undertaking more effective prevention measures.

Our results indicate there is scope to improve well-being among specific population groups. For example, programmes that target people high in neuroticism may get a bigger

bang for the buck than more widespread outreach efforts. It also may be possible to use personality traits to identify low-income people who, because of their predispositions, are at risk of severe mental health disorders. At the European level this is a topic of special interest, inasmuch as improved mental health will contribute to the attainment of key strategic policy objectives, such as the EU's Lisbon Strategy, which aims to make the Union the most dynamic, competitive, sustainable knowledge-based economy, enjoying full employment and strengthened social cohesion.

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TABLES

Table 2. Mental health (MCS) estimates

	Men (1)		Women (1)		Men (2)		Women (2)	
	Coeff.	z-statistic	Coeff.	z-statistic	Coeff.	z-statistic	Coeff.	z-statistic
Ln (household income)	0.779	1.92	1.496	3.54	0.744	1.83	1.550	3.67
Mean (Ln(household income))	0.853	2.56	1.232	3.81	0.870	2.61	1.214	3.76
Deprivation	-0.575	-3.16	-0.229	-1.18	-0.632	-3.46	-0.195	-1.00
Age < 30	-0.346	-1.04	0.175	0.51	-0.333	-1.00	0.170	0.50
30 ≤ Age < 40	-0.979	-3.50	-0.748	-2.59	-0.964	-3.45	-0.742	-2.57
40 ≤ Age <50	-1.494	-6.17	-0.897	-3.56	-1.484	-6.13	-0.892	-3.54
50 ≤ Age < 60	-1.677	-8.56	-1.133	-5.57	-1.666	-8.51	-1.131	-5.56
Ln(years education)	1.961	1.01	4.666	2.34	1.870	0.96	4.626	2.32
Ln (children)	-0.086	-0.42	0.494	2.07	-0.080	-0.40	0.501	2.10
Ln (adults)	-0.768	-2.06	-0.635	-1.58	-0.755	-2.03	-0.652	-1.63
Unemployed	-0.858	-4.03	-1.098	-4.98	-0.867	-4.07	-1.093	-4.95
Inactive	-0.551	-2.46	-0.272	-1.38	-0.571	-2.55	-0.273	-1.39
Single	0.852	3.92	0.178	0.75	0.863	3.97	0.174	0.73
Divorced	0.113	0.45	-0.010	-0.04	0.098	0.38	-0.002	-0.01
Widowed	-0.170	-0.32	-0.455	-1.32	-0.168	-0.32	-0.432	-1.25
Foreigner	1.026	3.38	0.039	0.12	1.010	3.33	0.032	0.10
Big Five dimensions and LOC								
Conscientiousness	0.966	11.30	0.715	7.81	0.965	11.29	0.718	7.83
Neuroticism	-2.526	-28.55	-2.818	-32.67	-2.531	-28.62	-2.810	-32.58
Extraversion	0.471	5.37	0.251	2.78	0.469	5.34	0.248	2.75
Agreeableness	0.343	4.07	0.643	7.07	0.349	4.13	0.641	7.05
Openness	-0.002	-0.03	0.268	2.99	-0.005	-0.05	0.269	2.99
External LOC	-0.884	-10.31	-1.129	-12.86	-0.890	-10.38	-1.118	-12.72
Interaction terms								
Deprivation* Conscientiousness					0.022	0.36	-0.112	-1.64
Deprivation* Neuroticism					-0.215	-3.23	-0.160	-2.44
Deprivation* Extraversion					-0.142	-2.17	0.020	0.30
Deprivation* Agreeableness					-0.005	-0.07	0.088	1.29
Deprivation* Openness					-0.188	-2.80	-0.047	-0.72
Deprivation* External LOC					0.000	0.00	-0.065	-1.03
Mundlak terms								
Mean (Unemployed)	0.314	0.60	0.318	0.58	0.358	0.69	0.343	0.63
Mean (Inactive)	-1.433	-3.75	-0.729	-2.26	-1.431	-3.74	-0.729	-2.26
Mean (Ln(years education))	-0.942	-0.47	-5.103	-2.47	-0.825	-0.41	-5.054	-2.44
Mean (Ln(children))	0.049	0.17	-0.198	-0.63	0.052	0.18	-0.198	-0.64
Mean (Ln(adults))	0.739	1.22	-0.387	-0.60	0.771	1.27	-0.361	-0.56
Region and year fixed effects	Yes		Yes		Yes		Yes	
R-squared (overall)	0.176		0.172		0.179		0.172	
No. of obs	27871		29955		27871		29955	

Notes to Table 2: i) Source: SOEP 2002-2010; ii) * denotes significance at the 10% level, ** denotes significance at the 5% level, *** denotes significance at the 1% level.

Table 3. Mental health (MCS) estimates – different subsamples

	Always Employed				Always married				Saver				Lagged deprivation			
	Men		Women		Men		Women		Men		Women		Men		Women	
	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.
Ln (household income)	0.420	0.84	1.024	1.79	0.097	0.20	2.038	4.09	-0.312	-0.58	1.492	2.59	1.707	6.76	2.365	9.41
Mean (Ln(household income))	0.876	2.37	1.315	3.46	1.015	2.45	1.379	3.53	0.728	1.63	1.095	2.43	0.249	0.57	0.206	0.49
Deprivation	-0.527	-2.30	-0.137	-0.48	-0.910	-4.27	0.089	0.39	-0.734	-3.08	0.131	0.50				
Deprivation t-1													-0.237	-2.39	-0.273	-2.65
Full set of controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Mundlak terms	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Region and year fixed effects	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
R-squared (overall)	0.152		0.153		0.179		0.178		0.163		0.164		0.183		0.176	
No. of obs	21168		21168		19876		19876		14702		14702		20024		21628	

Notes to Table 3: i) * denotes significance at the 10% level, ** denotes significance at the 5% level, *** denotes significance at the 1% level; ii) additional controls: years of completed education, household size (number of children and number of adults at home) and additional dummy variables for age, gender, employment status, marital condition, nationality, region and year fixed effects..

Table 4. Mental health (MCS)
estimates with deprivation-personality interactions – different subsamples

	Always Employed				Always married				Saver				Lagged deprivation			
	Men		Women		Men		Women		Men		Women		Men		Women	
	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.	Coeff.	z-stat.
Ln (household income)	0.402	0.80	1.069	1.85	0.115	0.24	2.099	4.20	-0.282	-0.52	1.439	2.49	1.663	6.57	2.391	9.50
Mean (Ln(household income))	0.874	2.37	1.303	3.42	1.021	2.46	1.333	3.40	0.700	1.57	1.108	2.46	0.243	0.56	0.171	0.40
Deprivation	-0.572	-2.48	-0.091	-0.34	-0.964	-4.48	0.088	0.38	-0.780	-3.23	0.149	0.56				
Deprivation t-1													-0.288	-2.83	-0.251	-2.39
Interaction terms																
Deprivation* Conscientiousness	-0.033	-0.43	-0.070	-0.84	0.001	0.06	-0.193	-2.03	0.001	0.01	0.018	0.15	0.055	0.77	0.121	1.50
Deprivation* Neuroticism	-0.162	-2.10	-0.183	-2.30	-0.235	-2.45	-0.129	-1.42	-0.066	-0.63	-0.341	-3.12	-0.199	-2.56	-0.101	-1.30
Deprivation* Extraversion	-0.048	-0.60	0.060	0.75	-0.058	-0.63	-0.020	-0.22	-0.039	-0.38	0.030	0.27	-0.051	-0.67	0.097	1.22
Deprivation* Agreeableness	-0.010	-0.12	0.002	0.03	-0.033	-0.34	0.193	2.03	-0.120	-1.14	-0.092	-0.78	-0.018	-0.24	0.025	0.31
Deprivation* Openness	-0.134	-1.70	-0.115	-1.44	-0.219	-2.32	0.028	0.28	-0.189	-1.72	-0.047	-0.42	-0.349	-4.42	-0.153	-1.96
Deprivation* External LOC	0.001	0.06	-0.049	-0.61	-0.039	-0.49	-0.058	-0.66	-0.128	-1.24	-0.063	-0.57	0.091	1.28	-0.169	-2.25
Full set of controls	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Mundlak terms	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Region and year fixed effects	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
R-squared (overall)	0.153		0.148		0.178		0.161		0.164		0.157		0.185		0.177	
No. of obs	21168		19932		19876		21207		14702		15063		20024		21628	

Notes to Table 4: i) * denotes significance at the 10% level, ** denotes significance at the 5% level, *** denotes significance at the 1% level; ii) additional controls: years of completed education, household size (number of children and number of adults at home) and additional dummy variables for age, gender, employment status, marital condition, nationality, region and year fixed effects.

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