Social Participation, Religion, and Health: Exploring the Endogeneity Issue at the Individual Level

Nicolas Sirven[†], **Thierry Debrand**
IRDES

OECD Workshop on Social Capital and Health
October 10th-11th, 2008 — IRDES, Paris (France)

Abstract

This study uses instrumental variables (IV) to investigate the causal influence of social capital on various health measures. The dataset consists of longitudinal and cross sectional data of SHARE 2004 and 2006 for respondents aged 50 and over in 11 European countries. A binary social capital variable is derived from participation (or not) in any of six social activities (helping friends, volunteering, etc.). Distinguishing religious beliefs from religious rituals or other social activities helped finding a valid instrument for social capital at the individual level. We found that social capital has a beneficial causal influence on self-rated health. IV Probit estimates also suggest that: (i) the impact of social capital on SRH is underestimated when correction for omitted variables bias is not taken into account, and (ii) social capital has an important lagged effect on maintaining people in good health (SRH) and reducing mental health troubles (Euro-D, cognitive impairments).

Keywords: Social Capital, Healthy aging, Instrumental variables, SHARE,

JEL Classification Codes: I12, Z13

† Correspondence should be send to Nicolas Sirven, IRDES, 10, rue Vauvenargues, 75018 Paris (France). Tel./Fax. +33(0)1 53 93 43 64. Email: sirven@irdes.fr.

1. Introduction

In just a decade, the literature on social capital and health has evolved from an analysis based on interpersonal networks and social support to encompass the more complex influence of individual and collective aspects of social interactions on health. The empirical studies, which supported such theoretical and conceptual developments, provide evidence that a wide range of individual and aggregated measures of social capital are correlated with various health outcomes (cf. Kawachi, Subramanian & Kim, 2008). Although ongoing research is already reconciling the two scales of analysis—*via* multilevel modeling for instance (e.g. Islam *et al.*, 2006)—, one of the core issues from the early stages of social capital is still pending.[1]

In a recent study, D'Hombres *et al.* (2007) used instrumental variables (IV) to address the problem that social capital is endogenous. By and large, their results suggest that higher levels of individual social capital (trust, membership in associations, and social isolation) lead to better health satisfaction, both before and after correcting for omitted variable bias. Maybe one weakness of this work is that using instruments which referred to the aggregated scale (heterogeneity in the communities in terms of religious beliefs, average level of social capital, etc.) could bias the results, especially in the case of "membership in associations" where no robust association is found. Nevertheless, the study by D'Hombres *et al.* has the virtue to bring into play "religious beliefs" as a potential instrument for social capital.

Attidutes towards "religion" are almost never suggested as a valid instrument at the micro scale because it is a good predictor of health (Herbert *et al.*; 2007; Levin, 1994): religious institutions may contribute to better health, by helping individuals to control adverse health behaviors, such as drinking, smoking or drug use (Crowther et al. 2002), and they may provide social capital in the guise of social networks and support (Olphen *et al.*, 2003).

[1] According to Kawachi (2007: 991-992): "Existing studies, even those with a panel design have not adequately dealt with the problem that social capital is endogenous. At the individual level, it is not completely established whether good health is the result of social capital or whether social capital is the result of good health and/or other unmeasured personal characteristics that determine both health status and patterns of social engagement. […]."

However, Yeager *et al.* (2006) question to what extent the purported health benefits are attributable to religion or to social activity in general?

The difference between religious beliefs and religious rituals (e.g. attending churches, meeting people) or other forms of social participation, is indeed of crucial importance. The fact that people who have religious beliefs have a higher tendency to get involved in various voluntary associations—i.e. not only religious activities—(Gruber, 2005; Lehrer, 2004; Wilson & Musick, 1997; Wilson & Janoski, 1995) supports the assumption that social participation is a potential mediator through which religious beliefs may benefit health. It thus makes it possible to differentiate between "membership in any associations" (or social capital) and "religious beliefs." Could the later be a good instrument for the former?

Investigating the influence of religion on older Europeans' health, we found no influence of religious beliefs, while a strong correlation was found between membership in social activities on a set of health measures. Although correlations are frequently unobserved between some proxies of social capital and self-reported health (Ziersch & Baum, 2004; Greiner *et al.*, 2004; Veenstra *et al.*, 2005; D'Hombres *et al.*, 2007) or other health outcomes (Ellaway & Macintyre, 2007), a close look at the literature advocates that the positive effects of social participation on health could be significant for the sub-population of older people (Veenstra, 2000; Kondo *et al*., 2007). One reason could be that older people have more time to take part in social activities due to retirement (Christoforu, 2005) or fewer familial constraints (Bolin *et al*., 2003). Investment in social capital could thus help maintaining older people in good health.[2]

This hypothesis is hereafter being tested using individual cross-section and panel data of Europeans aged 50 years old and over, in eleven countries from the two waves of the Survey on Health, Ageing, and Retirement in Europe (SHARE) in 2004 and 2006. Based on a theoretical approach of social capital as interpersonal network (Folland, 2008; Sirven, 2008; Dasgupta, 2005), a binary index of social participation is derived from self-reported questions on membership in associations, and help provided to family, friends, and neighbors. The

[2] At least two arguments may help in justifying this assumption. First, the number of cohort acquaintances an individual has throughout his life may decrease after a certain age (Glaeser et al., 2002). Involvement in associations and other social groups may help maintaining (if not increase) the size of social networks. Second, retirement has been found to be associated with a decrease of individuals' cognitive capacities (Adam et al, 2006). Social participation may slow down this process as it often requires cerebral efforts from the individuals and thus help preserve their mental health (cf. Almedom, 2005).

influence of this variable on health is estimated with and without use of "religious beliefs" as the sole instrument. In addition to the usual tests of endogeneity and instruments validity, the stability of the causal relationship between social capital and health is investigated *via* (i) five health outcome measures (self-rated health, symptoms of depression, cognitive impairments, CVD, and ADL or IADL), (ii) different sets of covariates in the regressions, and (iii) a time dimension in the dependant variables to account for a potential lagged effect of social capital on health—i.e. respondents' health status in the second wave (2006) is analyzed as a function of their individual characteristics in wave 1 (2004).

The paper is structured as follows: the next section presents the models and the tests for instrument validity. The variables used in the analysis are detailed in the data section. The results section compares Probit and IV Probit estimates of the determinants of self-rated health. The stability of the causal relation between social capital and health is then tested using sensitivity analysis. A discussion sums up our results and provides some possible ways for further research.

2. Method

2.1. The model

The implementation of IV in the case of a binary dependant variable for health with endogenous dummy for social participation requires the use the following standard bivariate probit regression model (Greene, 2008):

$$H_i^* = \beta_1' X + \gamma S_i + \varepsilon_i, \qquad H_i = 1 \text{ if } H_i^* > 0, \text{ and } H_i = 0 \text{ elsewhere;} \tag{1}$$

$$S_i^* = \beta_2' X + \Gamma' Z + \mu_i, \qquad S_i = 1 \text{ if } S_i^* > 0, \text{ and } S_i = 0 \text{ elsewhere;} \tag{2}$$

where health (H_i) of person *i* depends on her participation in social activities (S_i) and other socio-economic variables (X). Eq. (2) indicates that social participation (S_i) is simultaneously determined by the same set of covariates (X) but uniquely depends on a set of instruments (Z). β_1', β_2', γ, and Γ' are the coefficients to estimate by the maximum likelihood method under the assumptions that the residual terms ε_i and μ_i are uncorrelated with the exogenous variables

of the model, and they have a joint probability distribution that is bivariate normal, i.e. $E[\varepsilon_i] = E[\mu_i] = 0$, and $V(\varepsilon_i) = V(\mu_i) = 1$. Notice that, as a consequence, the correlation between the errors is given by $\rho_{\varepsilon,\mu} = \text{cov}(\varepsilon_{i,} \mu_i)$.

2.3. Testing for exogeneity and instrument validity

An IV model is only useful to test for the causal influence of social capital on health if the assumption that the social capital variable (S_i) is exogenous does not hold. An "endogenity test" based on the value of $\rho_{\varepsilon,\mu}$ could help investigate this issue (cf. Bollen *et al.*, 1995:117). If the residuals in both equations are not significantly correlated ($\rho = 0$), then $\hat{\gamma}$ in Eq. (1) cannot be assumed to be biased. However, $\rho_{\varepsilon,\mu} \neq 0$ indicates that Eq. (1) and Eq. (2) should be estimated simultaneously to take into account unobservable individual characteristics influencing both individual's social participation and their probability to be in good/bad health. A significant value of rho (i.e. LR test rejects H0) thus indicates that S_i is endogenous.[3]

The other important question in any IV regression is whether the instruments (Z) are valid. The validity of the instruments depends on two conditions: whether the variables in Z are sufficiently correlated with social participation, and whether they are legitimately excludable from Eq. (1). Although univariate probit or logit models could be used, the following bivariate probit model could be more interesting:

$$H_i^* = \alpha_1' X + \lambda_1' Z + e_i, \qquad H_i = 1 \text{ if } H_i^* > 0, \text{ and } H_i = 0 \text{ elsewhere;} \tag{3}$$

$$S_i^* = \alpha_2' X + \lambda_2' Z + u_i, \qquad S_i = 1 \text{ if } S_i^* > 0, \text{ and } S_i = 0 \text{ elsewhere} \tag{4}$$

Instruments are considered as valid if, according to a t-test, $\lambda_1 = 0$ and $\lambda_2 \neq 0$, i.e. Z does not influence health, and it is a good predictor of social participation. Notice that once again, the correlation coefficient between the residuals of the two equations report the influence of individual unobserved heterogeneity on both health and social capital. This bivariate method could thus be more precise to test for the validity of instrument than the recourse to two univariate probit models for Eq. (3) and (4) separately.

[3] From the form of the Likelihhood, If $\rho = 0$, then the Log Likelihood for the Bivariate Probit model (1-2) is equal to the sum of the Log Likelihoods of the two univariate Probit models (1) and (2) separately estimated. A likelihood-ratio (LR) test may therefore be performed by comparing the Likelihood of the full Bivariate model with the sum of Log Likelihoods for the univariate models.

3. Data

3.1. The survey

This study used longitudinal and cross-section of individual-level data from of the two first waves of the Survey on Health, Ageing and Retirement in Europe (SHARE) collected in 2004 and 2006. SHARE has been developed on the basis of prior successful experiments which are the Health and Retirement Study (HRS) in the United States, and the English Longitudinal Survey of Ageing (ELSA). SHARE is a bi-annual longitudinal survey with the aim to carry out international comparisons and analysis of economic and social problems related to ageing. Full rank data matrix of the first wave consists of about 27,000 individuals (depending on the measure of health), aged 50 and over, surveyed in 11 countries (Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, Spain, Sweden, and Switzerland). Although the second wave was extended to the Czech Republic and Poland, we shall focus here on the initial 11 countries for longitudinal analysis purposes—making the panel data to reach about 17,000 individuals in the two waves. Tables A1 to A3 in annex present descriptive statistics by country of the following variables retained in the analysis.

3.2. Dependant variables

Data collected include several health variables of which five are retained in the analysis. The self-rated health (SRH) question ranked health status from excellent to poor. With the aim to make our results comparable to other studies, this variable was dichotomized, taking the value 1 for people reporting health status being good or less than good, and the value 0 for very good or excellent status. Alongside SRH, two variables of mental health and two variables of physical health have been retained. About the latter set of health measures, a dummy takes the value 1 for people having difficulties in activities of daily living (ADL) or difficulties in instrumental ADL (IADL), and 0 otherwise. A binary index of cardiovascular disease (CVD) indicates whether people reported doctor told them they had either heart attack, a stroke, some cholesterol, or diabetes.

About mental health, an index of relative cognitive impairments was derived from a cognitive score (Adam *et al.*, 2006) based on a memory test (20 items recall) and a test of

executive functions (measuring verbal fluency based on naming as many animals as one can think of). The cognitive impairment dummy takes the value 1 for people whose score is below a minimum value—established at 1.5 standard deviation below the mean (Dewey & Prince, 2005). The other variable of mental health is based on the euro-d scale (Prince *et al.*, 1999). The binary index take the value 1 for individuals reporting more than three depressive symptoms out of twelve (among depression, pessimism, culpability, irritability, etc.), and 0 otherwise.

3.3. Social capital, instruments, and other covariates

A binary variable for social capital is derived from the participation (or not) to five social activities (voluntary/charity work, training course, sport/social club, religious organization, and political/community organization), and whether the respondent has recently given help to family, friends, or neighbors. Individual *i* will be assigned 1 as her social capital value if she took part in at least one of these social activities, and 0 elsewhere.

As discussed in the introduction, the sole instrument used in this study refers to religious beliefs. People in the first wave of SHARE were asked "What religion do you belong or feel attached to mostly?" Any respondent who reported a religion (Catholic, Protestant,…, other) was attributed the value 1, and 0 otherwise. In order to distinguish people reporting "no religion" from those who did not answer the question, another dummy variable was created, taking the value 1 for missing data, and 0 for individuals with no religious beliefs. This procedure is useful to avoid sample reduction since there is a large share of respondents who did answer the question in every country (cf. Table A2 in annex). Notice that, since French and Belgian people were not asked about their religious beliefs for legal reasons, the dummy for missing values could capture the country fixed effect. In order to avoid such a bias, country dummies are added—together with other controls—in the regressions.

=> homogeneous (why no distinction between types of religions)

The other covariates are gender, age, the number of years of education, quintiles of income within each country, marital status, and country dummies—as already mentioned. Additional regressors for sensitivity analysis are the number of children, whether the respondent is a migrant, and the respondent's status on the labor market (employed, unemployed, retired, housekeeper, and other inactive).

4. Results

4.1. Endogenous social capital and SRH

Table 1 reports the univariate Probit estimates of the determinants of SRH. The correlation coefficient between social capital and SRH indicates that older Europeans involved in social activities have a higher tendency to report better health status. Statistical inference points out that the model is quite satisfying since correctly predicted outcomes are high enough (72.16%) and the usual predictors of health status are significant and associated with the expected signs for the overall sample. Unsurprisingly, age is a very powerful predictor in the decline of health status, and *ceteris paribus* respondents with higher levels of income (quintiles 3, 4, 5) report lower levels of SRH, and those who have higher levels of education report better health status. Notice that men declare their health is excellent or very good more often than women, and more surprisingly, living as a couple (spouse) does not influence SRH.[4] After controlling for confounding variables, country rankings confirm the well-known north-south health gradient in Europe. Taking Germany as the benchmark country, France, Italy and Spain have the highest values of poor SRH, whereas Denmark and Sweden have the lowest values.

– TABLE 1 ABOUT HERE –

The influence of the previous covariates in the IV Probit model remains comparable with the univariate Probit estimates. The same covariates are simultaneously associated with SRH and social capital—our results are comparable with the literature on the determinants of social capital (Kaasa & Parts, 2007; Erlinghagen & Hank, 2006; Christoforou, 2005). The only noticeable difference in Table 1 deals with the value of the social capital coefficient. Correction for omitted variables bias seems to increase its value from –0.183 to –0.676 (some interpretations of this effect are provided in the discussion). In other words, taking part in social activities could have a more powerful impact on SRH than one would think—based on univariate analysis.

[4] In other studies, a common finding is that spouse contributes to health. One could think that family and social capital trade off here. However, we found that spouses' SRH (substituted with the dummy "living as a couple") is strongly and positively associated with respondents' SRH. This result is perhaps due to the specific nature of the sample of older people.

Gaining confidence in the idea that the effect of social capital on health is causal first requires that social capital is endogeneous. As detailed in the method section, an LR test comparing the bivariate and univariate Log likelihoods of the two equations in Biprobit models and provides information on the significance level of the coefficient of correlation (rho) between the residuals. In our case, the Chi^2 statistic (5.022; $p<0.05$) support the hypothesis that social capital is endogenous.

4.2. Testing for instrument validity and other health outcomes

Table 2 recapitulates the previous results and extends the analysis to other health outcomes and model specification. First, the relationship between social capital and health is investigated for five dependant variables with the same covariates as displayed in Table 1. Second, a set of additional independent variables are included in the models (labor market status, number of children, being a migrant). Third, respondents' health status in the second wave (2006) is analyzed as a function of their individual characteristics in wave 1 (2004). This later procedure is another way at looking at the causality issue through the hypothesis of a lagged effect of social capital on health.[5]

– TABLE 2 ABOUT HERE –

Table 3 sums up the tests for instruments validity. By and large, religious beliefs is a valid instrument whatever health outcome or model specifications are. Notice that the LR tests for rho show that the bivariate estimates for the instruments are more precise than the univariate ones—but in the case of CVD in 2006.[6] The only models where exclusion restrictions are not being satisfied is in the case of cognitive impairments 2004: the item "missing values" is correlated with the health outcome. One possible interpretation is that people with cognitive impairments (e.g. due to Alzheimer) may have experienced difficulties in answering some questions. Apart from that very case, distinguishing religious beliefs from religious rituals or other social activities helped finding a valid instrument for social capital at the individual level.

– TABLE 3 ABOUT HERE –

[5] Notice that the sensitivity analysis does not significantly affect the estimates in the social capital equation, even when additional covariates are inserted in the model.
[6] Univarite Probit estimates also confirm that religious beliefs items are not correlated with CVD 2006.

Tables 2 and 3 reveal that social capital is not found to be a causal factor of 2004 measures of physical health (CVD and ADL or IADL) or mental health (Euro-D, cognitive impairments), though significant simple correlations (univariate Probit) are almost always found. The reason being that (i) LR tests reject the hypothesis that social capital is exogenous only in the case of cognitive impairments (in 2004), and (ii) the instruments for cognitive impairments (in 2004) do not respect the exclusion criteria. On the one hand, our results concur with previous work on since univariate correlations support the idea that taking part in voluntary associations had protective effect on functional dependency, depression, and functional capacity of older adults (Zycinska, 2008; Kondo *et al*, 2007; Musick & Wilson, 2002). On the other hand, we cannot state that the correlation denotes causality from social capital to health. The same interpretation applies for CVD, with the difference that, unlike Ellaway & Macintyre (2007), we do find a significant correlation between social capital and low rates of CVD.[7]

Nevertheless, statistical inference indicates that both the endogeneity of social capital and the validity of instruments are satisfied conditions in the case of 2006 mental health measures. Taking part in social activities in 2004 seems to reduce cognitive impairments and symptoms of depression (Euro-D) in 2006. This lagged effect of social capital is also found to be plausible in the case of SRH. Our findings even indicate that social capital is endogenous for SRH whatever the model specification and the outcome variable are. In every cases, social capital is negatively and significantly associated with poor SRH, and the IV Probit estimates for social capital are always higher than the univariate Probit values, suggesting that omitted variable bias could underestimated the impact of social capital on health.

5. Discussion

A key finding in this study supports the assumption that social capital has a beneficial causal influence on various measures of health. More precisely, it seems that (i) endogenous social capital impacts SRH whatever the specification of the model is, and (ii) the lagged influence of social capital is not only quite important for SRH, but also for mental health

[7] This result may once again be due to the specific sample of older perople. Ellaway & McIntire's (2007) study indeed focuses on a more general population.

outcomes such as Euro-D, and cognitive impairments—once corrected for omitted variables bias.

In the case where the conditions for endogeneity and exclusion restriction are satisfied, the IV Probit estimator thus reveals that the usual Probit estimates are affected by relatively large endogeneity biases. More precisely, it seems that the impact of social capital on older people's health could be underestimated when the influence of omitted variables is not taken into account. The most plausible reason is that the dichotomous variable of social capital only represents an approximation of people's extensive involvement in social activities and that univariate Probit estimates are affected by biases linked to measurement error. Another potential reason is that some unobserved individual characteristics negatively influence health and positively influence the decision to participate in social activities. Special attention could be given to the influence of changes in household structure between the two waves, with the intuition that people experiencing recent loneliness (divorced, widowed) have less social and emotional support and may suffer from depression, and at the same time, they may want to join a social club to lessen loneliness. Further research could explore the pathways between changes in household structure, social participation, and health. A third potential reason is that the social capital estimate is biased down by reverse causation: healthy people who do not need social support, do not invest time and effort in socializing.

For these statistical results to be useful for further research requires to provide a theoretical pathway towards the important literature on the influence of religious beliefs on health related behaviors. First of all, it appears of foremost importance to distinguish between religious beliefs and religious rituals or other social activities. Promoting social participation for healthy aging is perhaps a more practicable public health policy than focusing on trying to enhance religiosity of the nation. Second, one should keep in mind that this study investigates the impact of social capital on older people's health. The population is quite specific and previous research indicates that the influence of social capital may be higher among older people. We believe that a better understanding of the social and health aspects of the aged population is a necessity since aging is one ongoing challenge of modern societies.

Acknowledgements

"The SHARE data collection has been primarily funded by the European Commission through the 5th framework program (project QLK6-CT-2001-00360 in the thematic program Quality of Life). Additional funding came from the US National Institute on Ageing (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064). Further support by the European Commission through the 6th framework program (projects SHARE-I3, RII-CT-2006-062193, and COMPARE, CIT5-CT-2005-028857) is gratefully acknowledged. For methodological details see Börsch-Supan & Jüerges (2005)."

References

Adam S., Bay C., Bonsang E., Germain S. & Perelman S. (2006). Occupational Activities and Cognitive Reserve: a Frontier Approach Applied to the Survey of Health, Ageing and Retirement in Europe (SHARE), CREPP WP 2006/05, HEC School of Management, University of Liege (Belgium), mimeo.

Almedom A. M. (2005). Social capital and mental health: An interdisciplinary review of primary evidence. *Social Science and Medicine*, 61(5), 943–964.

Bolin K., Lindgren B., Lindstrom M., & Nysetdt P. (2003). Investments in social capital—implications of social interactions for the production of health. *Social Science and Medicine*, 56(12), 2379–2390.

Bollen A.K., Guilkey D.K. & Mroz TA. (1995). Binary outcomes and endogenous explanatory variables: Tests and solutions with an application to the demand for contraceptive use in Tunisia. *Demography*, 32(1), 111-131

Börsch-Supan A. & Jürges H. (2005) Eds. *The Survey of Health, Aging, and Retirement in Europe—Methodology*. Manheim Research Institute for the Economics of Ageing (Germany).

Cameron A.C. & Trivedi P.K. (2005). *Microeconometrics. Methods and Applications*. New York: Cambridge University Press.

Christoforou A. (2005). On the Determinants of Social Capital in Greece Compared to Countries of the European Union. Working paper No 68, Fondazione Eni Enrico Mattei (Italy), mimeo.

Crowther M. R., Parker M. W., Achenbaum W. A., Larimore W. L. & Koenig H. G. (2002). Rowe and Kahn's model of successful aging revisited: Positive spirituality—the forgotten factor. *The Gerontologist*, 42(5), 613–620.

D'Hombres B., Rocco L., Suhrcke M. & McKee M. (2007). Does social capital determine health? Evidence from eight transition countries. Institute for the Protection and Security of the Citizen (European Commission), mimeo.

Dasgupta P. (2005). Economics of Social Capital. *Economic Record*, 81(S1), S2–S21.

Dewey M. & Prince M.J. (2005). Cognitive function. *in* Börsch-Supan, A., Brugiavini, A., Jürges, H., Mackenbach, J., Siegrist, J. & Weber, G. (Eds.). *Health, Ageing and retirement in Europe*. Manheim Research Institute for the Economics of Ageing (Germany), 118–125.

Ellaway A. & Macintyre S. (2007). Is social participation associated with cardiovascular disease risk factors? *Social Science & Medicine*, 64, 1384–1391.

Erlinghagen M. & Hank K. (2006). The Participation of older Europeans in volunteer work. *Ageing & Society*, (26)4: 567–584.

Folland S. (2008). An economic model of social capital and health. *Health Economics, Policy and Law*, 3(04), 333–348.

Glaeser E.L., Laibson D. & Sacerdote B. (2002). The economic approach to social capital. *Economic Journal*, 112, 437–458.

Greene W.H. (2008). *Econometric analysis* (6th international edition). Pearson Education, New Jersey (US).

Greiner K., Li C., Kawachi I., Hunt D. & Ahluwalia J. (2004). The relationships of social participation and community ratings to health and health behaviours in areas with high and low population density. *Social Science & Medicine*, 59, 2303–2312.

Gruber J. (2005). Religious market structure, religious participation, and outcomes: Is religion good for you?. *Advances in Economic Analysis & Policy*, 5, Article 5.

Hebert R.S., Qianyu D. & Schulz R. (2007). Religious beliefs and practices are associated with better mental health in family caregivers of patients with dementia: Findings from the reach study. *The American journal of geriatric psychiatry*, 15(4), 292–300.

Islam M.K., Merlo J., Kawachi I., Lingström M. & Gerthan U.G. (2006). Social capital and health: Does egalitarianism matter? A literature survey. *International Journal for Equity in Health*, 5, 1–28.

Kaasa A. & Parts E. (2007). Individual-level determinants of social capital in Europe: Differences between country groups. University of Tartu (Estonia), mimeo.

Kawachi I. (2007) Commentary: Social capital and health: making the connections one step at a time. *International journal of Epidemiology*, 35, 989–993.

Kawachi I., Subramanian S.V. & Kim I. (2008). *Social capital and health*. New York: Springer

Kondo N., Minai J., Imai H. & Yamagata Z. (2007). Engagement in a cohesive group and higher-level functional, capacity in older adults in Japan: A case of the Mujin. *Social Science & Medicine*, 64, 2311–2323.

Lehrer E. (2004). Religion as a determinant of economic and demographic behavior in the United States. *Population and Development Review*, 30, 707–726.

Levin, J.S. (1994). Religion and health: is there an association, is it causal? Social Science & Medicine, 38(11), 1475-1482.

Musick M.A. & Wilson J. (2002). Volunteering and depression: the role of psychological and social resources in different age groups. *Social Science & Medicine*, 56(2), 259–269.

Musick M.A. & Wilson J. (2002). Volunteering and depression: the role of psychological and social resources in different age groups. *Social Science & Medicine*, 56(2), 259–269.

Olphen J., Schulz A., Israel B., Chatters L., Klem L., Parker E. & Williams D. (2003). Religious involvement, social support, and health among African-American women on the east side of Detroit. *Journal of General Internal Medicine*, 18(7), 549–557(9).

Prince M.J., Reischies F., Beekman A., Fuhrer R., Jonker C., Kivelä S.-L., Lawlor B., Lobo A., Magnús-son H., Fichter I., van Oyen H., Roelands M., Skoog I., Turina C & Copeland J. (1999). Development of the EURO-D scale – a European Union initiative to compare symptoms of depression in 14 European centers. *British journal of Psychiatry*, 174, 330–338.

Sirven N. (2008). Social capital: A critique and extension. *in* Davis J.B & Dolfsma W. (Eds.). *The Elgar Companion to Social Economics*. Cheltenham (U.K.), 373–389.

Veenstra G. (2000). Social capital, SES and health: An individual-level analysis. *Social Science & Medicine*, 50, 619–629.

Veenstra G., Luginaah I., Wakefield S., Birch S., Eyles J. & Elliott S. (2005). Who you know, where you live: social capital, neighborhood and health. *Social Science & Medicine*, 60, 2799–2818.

Wilson J. & Janoski T. (1995). The contribution of religion to volunteer work. *Sociology of Religion*, 56(2), 137–152.

Wilson J. & Musick M. (1997). Who cares? Towards an integrated theory of volunteer work *American Sociological Review*, 1997, Vol. 62, 694–71.

Yeager D.M., Gleia D.A., Auc M., Lind H.-S., Sloane R.P. & Weinsteinf M. (2006). Religious involvement and health outcomes among older persons in Taiwan. Social Science & Medicine, 63, 2228–2241.

Ziersch A., & Baum F. (2004). Involvement in civil society groups: Is it good for your health? *Journal of Epidemiology & Community Health*, 58, 493–500.

Zycinska J. (2008). Effects of volunteering on the physical and mental health of older adults: Does the type of volunteer work matter? *European Psychiatry*, 23(S2): S298-S299.

TABLES

Table 1: Determinants of self-reported health (≤ good) 2004

	Probit		IV Probit			
			Health equation (1)		Social capital equation (2)	
Indep. var.	Coef.	Robust S.E.	Coef.	Robust S.E.	Coef.	Robust S.E.
Social capital	-0.183***	0.018	-0.676**	0.204		
Socio-economic						
Age	0.025***	0.001	0.022***	0.002	-0.016***	0.001
Education (years)	-0.049***	0.002	-0.040***	0.005	0.040***	0.002
Gender (male)	-0.095***	0.017	-0.101***	0.017	-0.043**	0.016
Spouse	-0.026	0.021	-0.030	0.021	-0.037*	0.020
Income						
Quintile 1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Quintile 2	-0.001	0.027	0.023	0.029	0.123***	0.025
Quintile 3	-0.110***	0.027	-0.074**	0.031	0.179***	0.025
Quintile 4	-0.132***	0.027	-0.086**	0.034	0.225***	0.026
Quintile 5	-0.172***	0.028	-0.130***	0.034	0.201***	0.026
Country						
Germany	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
France	-0.274***	0.039	-0.231***	0.044	0.255***	0.037
Italy	-0.287***	0.043	-0.340***	0.045	-0.384***	0.039
Spain	-0.371***	0.045	-0.419***	0.047	-0.390***	0.042
Netherlands	-0.387***	0.037	-0.297***	0.056	0.424***	0.034
Belgium	-0.494***	0.035	-0.423***	0.050	0.367***	0.035
Austria	-0.512***	0.041	-0.482***	0.045	0.044	0.039
Greece	-0.668***	0.038	-0.588***	0.057	0.294***	0.037
Switzerland	-0.694***	0.051	-0.607***	0.067	0.327***	0.048
Denmark	-0.837***	0.042	-0.734***	0.067	0.399***	0.040
Sweden	-0.859***	0.036	-0.735***	0.072	0.521***	0.034
Constant	0.122	0.084	0.428**	0.150	0.224**	0.081
Instruments						
Religious beliefs					0.199***	0.033
Missing value					0.057	0.035
N	26,751				26,751	
Log L	-14754.9				-31686.8	
rho					0.306**	0.128
LR test : Chi² (p-val.)					5.022	(0.025)

Legend: * p<0.1; ** p<0.05; *** p<0.01

Table 2: Social capital estimates with different health outcomes[(a)]

Dependant var.	Sample	N	Probit		IV Probit			
			Coef.	S.E.[(b)]	Coef.	S.E.[(b)]	rho	LR test
SRH								
2006	Panel	17,358	-0.125***	0.022	-0.784***	0.288	0.411**	3.975
2004	Cross sect.	26,751	-0.183***	0.018	-0.676***	0.204	0.306**	5.022
2004 $_{\text{full covar.}}$[(c)]	Cross sect.	26,119	-0.192***	0.018	-0.696***	0.177	0.313***	6.960
Cognitive imp.								
2006	Panel	17,076	-0.317***	0.039	-0.797***	0.164	0.299***	7.975
2004	Cross sect.	26,431	-0.377***	0.032	-1.237***	0.126	0.541***	29.871
2004 $_{\text{full covar.}}$[(c)]	Cross sect.	25,811	-0.366***	0.033	-1.213***	0.147	0.531***	21.523
Euro-D								
2006	Panel	17,395	-0.093***	0.022	-0.783***	0.274	0.427**	4.787
2004	Cross sect.	26,709	-0.128***	0.018	0.401	0.552	-0.324	0.795
2004 $_{\text{full covar.}}$[(c)]	Cross sect.	26,079	-0.127****	0.018	0.398	0.495	-0.321	0.974
CVD								
2006	Panel	17,355	-0.012	0.021	-0.135	0.244	0.076	0.255
2004	Cross sect.	26,756	-0.042**	0.017	-0.376	0.243	0.206	1.775
2004 $_{\text{full covar.}}$[(c)]	Cross sect.	26,124	-0.051***	0.017	-0.413	0.252	0.223	1.924
ADL or IADL								
2006	Panel	17,395	-0.093***	0.021	-0.473*	0.242	0.235	2.285
2004	Cross sect.	26,756	-0.092***	0.017	0.095	0.203	-0.115	0.845
2004 $_{\text{full covar.}}$[(c)]	Cross sect.	26,124	-0.098***	0.017	-0.042	0.190	-0.034	0.085

Note: (a) Probit Biprobit estimates of social capital from Equations (1) and (1-2). Estimates for other covariates not displayed here. (b) Robust S.E. (c) Additional covariates are: Labor market status, Nbr. of children, and Being a migrant. Legend: * p<0.1; ** p<0.05; *** p<0.01

Table 3: Tests for the validity of exclusion restrictions[(a)]

Dep. var.	**Health 2004**		**Health 2004 (full covariates)**		**Health 2006**	
Indep var.	Coef.	Robust S.E.	Coef.	Robust S.E.	Coef.	Robust S.E.
SRH						
Religious beliefs	-0.005	0.034	-0.015	0.035	-0.067	0.043
Missing values	0.040	0.037	0.039	0.037	-0.036	0.047
rho	*-0.111****	*0.011*	*-0.116****	*0.011*	*-0.076****	*0.014*
Cognitive imp.						
Religious beliefs	-0.114	0.075	-0.092	0.076	-0.005	0.101
Missing values	0.148*	0.076	0.161**	0.077	0.167	0.104
rho	*-0.216****	*0.018*	*-0.211****	*0.019*	*-0.187****	0.023
Euro-D						
Religious beliefs	-0.011	0.037	-0.022	0.038	-0.783	0.274
Missing values	0.022	0.039	0.009	0.040	-0.422	0.028
rho	*-0.079****	*0.011*	*-0.078****	*0.011*	*0.427***	*0.170*
CVD						
Religious beliefs	-0.042	0.034	-0.050	0.035	-0.048	0.042
Missing values	-0.055	0.036	-0.058	0.037	-0.068	0.045
rho	*-0.025***	*0.010*	*-0.030****	*0.011*	*-0.007*	*0.013*
ADL or IADL						
Religious beliefs	-0.015	0.034	-0.034	0.035	-0.049	0.042
Missing values	-0.027	0.036	-0.036	0.037	-0.020	0.045
rho	*-0.057****	*0.010*	*-0.060****	*0.011*	*-0.056****	*0.013*

Note: (a) Biprobit estimates from Equations (3-4) for religious beliefs. Estimates for other covariates not displayed here. Wald test for significance of instruments; LR test for rho. Legend: * p<0.1; ** p<0.05; *** p<0.01

ANNEX

Table A1: Health – Descriptive statistics[(a)]

Countries	SRH (≤ good)		Euro-D		Cognitive imp.		CVD		ADL or IADL	
	2004	2006	2004	2006	2004	2006	2004	2006	2004	2006
Denmark	48.16	53.17	19.14	19.02	2.75	3.83	27.34	31.73	40.99	42.25
Sweden	53.27	60.76	22.06	21.06	2.08	2.9	33.51	34.41	44.64	46.02
Switzerland	55.09	55.92	21.56	17.51	1.8	3.02	23.8	23.24	36.98	36.38
Greece	64.16	68.48	26.74	18.24	5.43	7.43	37.3	38.78	54.63	59.14
Netherlands	67.05	73.93	20.81	19.12	1.91	2.78	28.32	27.85	42.87	38.19
Belgium	67.56	71.72	26.59	27.01	4.76	5.35	42.34	42.07	49	48.07
Austria	67.65	72.19	20.63	21.54	3.15	5.31	33.7	35.42	53.97	55.07
France	76.55	81.85	36.86	33.24	6.09	7.52	39.07	39.1	49.49	47.19
Germany	79.72	81.27	21.06	22	2.65	3.24	34.41	34.79	53.17	50.07
Italy	79.94	84.12	36.25	37.29	12.92	13.7	35.1	38.02	53.69	57.4
Spain	81.95	89.01	39.78	32.81	15.6	17.6	40.44	41.54	59.47	55.13
Total	**67.94**	**72.79**	**26.96**	**24.93**	**5.43**	**6.6**	**35.37**	**36.34**	**49.58**	**49.4**

Note: (a) Panel data, unweighted. Percent of non-missing values.

Table A2: Social capital and religious beliefs – Descriptive statistics 2004[(a)]

Countries	Social participation							Religious beliefs	
	Friends, etc.	Voluntary	Education	Social, sport	Religious	Political	**Any of these**	Believers	Missing[(b)]
Denmark	32.83	17.69	9.72	31.28	5.05	4.8	61.98	84.76	32.7
Sweden	38.31	17.9	12.05	24.17	6.72	4.6	61.68	84.75	30.14
Netherlands	29.1	20.91	7.44	27.06	10.39	3.24	59.32	71.86	22.06
Switzerland	21.19	14.35	16.2	32.68	12.25	7	58.91	91.23	35.46
Belgium	28.82	15.72	9.1	22.08	6.77	6.8	53.51	-	100
Greece	13.16	3.07	3.61	5.5	36.8	5.06	53.44	98.73	13.85
France	27.06	13.76	3.96	18.14	5.85	2.95	48.44	-	100
Austria	21.32	8.48	3.75	14.14	21.7	5.27	47.16	86.56	19.57
Germany	16.91	10.24	5.78	24.05	9.13	3.46	45.98	79.18	29.83
Italy	13.02	7.01	1.03	5.33	4.88	2.25	25.63	95.93	37.42
Spain	6.08	2.2	1.81	6.31	12.74	1.29	25.59	94.53	31.44
Total	**18.11**	**9.83**	**4.53**	**16.34**	**9.93**	**3.24**	**41.81**	**87.1**	**39.87**

Note: (a) Percent of non-missing values. Weighted statistics (design weights). (b) N = 33,481 individuals.

Table A3: Income, education, and demography – Descriptive statistics 2004[(a)]

Countries	Annual income *per* UC (€)		Years of education		Age				Men	Married
	Mean	S.E.	Mean	S.E.	50-59	60-69	70-79	≥ 80		
Switzerland	53546.5	1489.3	12.2	0.14	37.09	30.35	22.51	10.05	46.74	72.67
Denmark	42635.2	880.2	12.7	0.09	40.48	28.34	20.57	10.61	47.08	68.61
Netherlands	36164.7	689.3	11.0	0.07	42.08	29.17	18.91	9.83	46.95	72.32
Sweden	35454.0	482.0	10.3	0.06	37.29	30.62	20.22	11.87	46.65	68.66
France	34045.2	946.5	8.6	0.13	40.29	26.25	23.09	10.37	45.24	70.6
Belgium	33431.8	814.0	10.3	0.07	39.19	27.56	22.34	10.9	46.95	75.86
Germany	31891.0	636.6	13.4	0.06	34.72	36.91	20.28	8.09	45.99	70.31
Austria	28849.2	611.7	11.4	0.06	31.21	38.89	21.09	8.81	42.03	64.74
Italy	19426.3	453.5	7.0	0.10	32.54	37.03	23.06	7.38	46.07	74.13
Spain	15313.6	459.8	5.3	0.10	29.79	29.97	26.5	13.74	44.54	69.75
Greece	11723.7	271.2	8.4	0.11	37.04	29.37	23.32	10.27	45.74	68.88
Total	**27112.9**	**200.1**	**9.8**	**0.03**	**34.93**	**33.46**	**22.21**	**9.41**	**45.71**	**71.08**

Note: (a) Percent of non-missing values. Weighted statistics (design weights).