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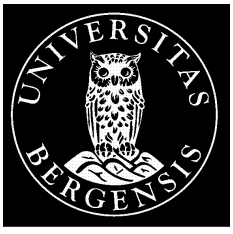

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The Social Capital and Health Hypothesis: A Theory and New Empirics Featuring the Norwegian HUNT Data*

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Abstract

We develop and explore an economic model in which cigarette consumption enhances utility but reduces the probability of survival through the period. Social capital is produced by time spent developing and maintaining social relationships. By requiring time inputs, social capital has an opportunity cost, represented by the wage. Elements exogenous to the subject's decision making, such as the introduction of city parks, new social clubs, or the influence of local social norms enhance the productivity of time spent in social activity so as to produce utility. This framework is cast deliberately in a compact model so as to reveal fundamental relationships and permit clear comparative static analysis. These are tested in a Norwegian longitudinal data set new to this field of study.

JEL: I10, I12 , Z3

Key words: Social norms and social capital, HUNT data set

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1 Introduction

This paper addresses the questions of whether and how social capital affects the probability of smoking and thus health. It develops both theory and new empirics on a rich new panel data set in the effort to integrate many of the ideas from the wide, interdisciplinary literature on the role of social networks on health risky behaviors. The work explains the mechanisms of a simple static model under uncertainty, and implications of the model are tested against an extraordinarily rich longitudinal Norwegian data set not before applied in this field: The North-Trøndelag Health Study—known as the HUNT data.

The idea that one's social milieu and social experience affect one's physical circumstance and well-being has an ancient history. In our era, the concept of social capital was brought forward by Glenn Loury (1977), Pierre Bordieu (1985), James Coleman (1988), and most prominently in the recent work of Robert Putnam (2000, 1995, and 1993). They described the effects of social ties in family, networks of friends and relationships to the community as being important contributors to socio-economic outcomes that could not be explained by a conventional, rational economic model. For example, educational outcomes, crime rates, TV watching by children, and measures of health, have all proved to be beneficially associated with social capital. The health connection alone attracted many researchers and a large literature on it has grown up. For example: Kawachi (1999); Kawachi, and Berkman (2001); Poortinga (2006); and Turrell, Kavanagh, and Subramanian (2006). Economists have been prominent in conceptual studies of social capital: Glaeser et al. (2002); Becker and Murphy (2000); Durlauf, (2002); and Akerlof (1998). But only recently have health economists focused on the social capital and health hypothesis and thus giving the subject more attention to econometric issues. Among these are Mellor and Milyo (2005); Islam et al. (2006a, 2006b, 2008); Folland (2006, 2007, 2008); Brown et al. (2006); Laporte and Ferguson (2004); and d'Hombres, Rocco, Suhrcke, and McKee (2010).

The social capital and health hypothesis simply stated is the proposition that improvements in a person's individual or community social capital will cause, ceteris paribus, improvements in the person's health. The hypothesis poses econometric difficulties because it requires success in sorting out influences of other variables and addressing the endogeneity questions. However, the hypothesis remains plausible because there are known pathways by which social ties could have the hypothesized effect: 1) friendship and sociability often reduce stress, and stress is known to cause reductions in health (Sapolsky, 1998); 2) social contacts provide new information sources about healthy behaviors and medical procedures; 3) following Coleman (1988), social ties enhance one's sense of obligation to loved ones, friends and by implication to oneself (also Folland, 2006); and 4) by joining in groups, people may be able to better influence the development of better community health services (Mellor and Milyo, 2005; Kawachi et al., 1997)

There have been several studies of the relationship of social capital and smoking; though only a few have been developed in an economic framework. First consider the literature from outside of economics, studies from medical, epidemiological and psychological literature.

Sapag and colleagues (2010) found a significant inverse relation between a measure of "trust in neighbors" and cigarette smoking in an urban setting in

Santiago, Chile. Afifi, Nakkash and Khawaja (2010) also studied an urban setting, in this case in Beirut, Lebanon and in low-income neighborhoods where they found negative correlations with smoking and "trust of friends and neighbors". Giordano and Lindstrom (2010) found trust and participation in groups to be associated with smoking cessation. Lindstrom, Isacsson and Elmstahl (2003) found that social participation is positively associated with smoking cessation. Lee and Kahende (2007) studied factors that encouraged quitting in the United States and inter alia found that being married or living with a partner were important (see also Homish and Leonard, 2005). Studies of adolescents (Glaser, Sheton and van der Brie, 2010; Stewart-Knox et al. 2005; Page et al. 2006; Chaleda, Velez and Ramirez, 2007) find that peer smoking behaviors are especially influential; and the social effect may encourage smoking if the peer cohort smokes. These may support the social capital and health hypothesis, but they neither address econometric issues such as the role of fixed or random effects nor the endogeneity issue.

Health economists have recently also studied social capital and smoking. Folland (2006) theorized how social capital would alter one's desired rate of trade between risk and reward, supporting this with data on several health risky behaviors in a cross-section of the U.S. states. Brown et al. (2006) developed a "Petris Social Capital Index" and showed that a portion of this as associated with membership in a religious organization seems to encourage reduced smoking. Folland (2008) developed an economic model based on utility maximization and showed that when smoking reduces health and lowers the probability of survival, exogenous increases in social capital can reduce the smoking. That model was tested on data from the National Longitudinal Survey of Youth 79, where a community social capital measure proved to be negatively associated with smoking.

The present study fills a gap in the prior literature by developing a model in which alternatively social capital can be produced by using one's time as an input, correspondingly incurring an opportunity cost, and also one can respond to social capital provided exogenously. The model is tested on a rich data panel new to this literature and estimates are developed by econometrically appropriate methods.

To introduce the complex relationships of social capital to cigarette consumption, we offer a compact model under uncertainty.

The paper is organized as follow. In Section 2 we outline the theory model, while Section 3 describes the social capital variables and the hypotheses. Section 4 describes the data, variables and the econometic approach we use, and in Section 5 we present our results. Section 6 presents our conclusions and indicates avenues for future research.

2 A Static Model of Social Capital and Cigarette Consumption Under Uncertainty

The best way to describe social capital is first to recognize that it takes time and energy to develop and maintain social networks. Let S represent the personal time spent doing so. For economy of notation, let social capital be produced solely by S in fixed proportions so that S provides a scale for social capital

itself. Exogenous features of the social milieu, E, from the point of view of the individual subject, such as parks, playgrounds or local social norms, if they are beneficial, enable the subject to obtain a greater marginal utility out of each social capital hour S. These features do not require the subject's time to develop.

Let the objective function be as in Equation (1):

$$\omega(c)\,U(S,E,c) + (1-\omega)\,U(0,E,0), \tag{1}$$

where ω is the survival rate S is social capital measured as hours spent developing and maintaining social networks, E is exogenous community features that enable social capital productivity, and c is cigarette consumption. Here, $\omega_c < 0$; $U_S > 0$; $U_{SS} < 0$; $U_{SE} > 0$; $U_c > 0$; $U_{cc} < 0$; $U_{Sc} < 0$. That is, we have defined a single period model with two states, survival and death. Without loss of generality, $U(0,E,0)$ is treated as zero. What is the purpose of reducing the model to the level of simplicity of Equation (1)? We will show in what follows that the model reveals micro fundamentals while retaining clarity.

For simplicity, we treat the survival probability as linear, thus $\omega_{cc} = 0$. Cigarette smoking is a pleasure, $U_c > 0$, but it harms one's chance of surviving the period, $\omega_c < 0$. Social capital and cigarette smoking are probably substitutes for most people, $U_{Sc} < 0$, but see comments below. We also assume that the marginal utility of cigarettes is independent of exogenous social capital E, i.e., $U_{cE} = 0$. Assume a 24 hour period and a wage of w, the opportunity cost of S. With p_c as the price of cigarettes, the Lagrangian function to be maximized becomes:

$$\mathcal{L} = \omega(S,E,c) + \mu\left[w(24-S) - p_c c\right]. \tag{2}$$

The First Order Conditions are given in the following Equations:

$$\mathcal{L}_S = \omega U_S - \mu w = 0 \tag{3}$$

$$\mathcal{L}_c = \omega_c U(\cdot) + \omega U_c - \mu p_c = 0 \tag{4}$$

$$\mathcal{L}_\mu = w(24-S) - p_c c = 0 \tag{5}$$

Equations (3) and (4) together imply that

$$\frac{\omega U_S}{\omega_c U(\cdot) + \omega U_c} = \frac{w}{p_c}. \tag{6}$$

This is the standard optimal purchase condition: the marginal rate of substitution between social capital and cigarettes is equal to the relative price level of the two goods.

The effect of change in the parameters can be seen through Equation (6). Let w increase, $\Delta w > 0$. The restoration of equilibrium suggests itself as a decrease in endogenous social capital, S; via diminishing marginal utility, this raises the numerator. It is natural to think that a rise in cigarette consumption, $\Delta c > 0$, would likewise tend toward equilibrium; but this won't necessarily occur, because the denominator is also a function of S. This is seen in the

comparative static Equations $(7-10)$.

$$\frac{\partial S}{\partial w} = \frac{\left\{-\mu p_c^2 - (24-S)\left[-p_c\left(\omega_c U_S + \omega U_{Sc}\right) + w\left(2\omega_c U_c + \omega U_{cc}\right)\right]\right\}}{|J|} \tag{7}$$

$$\frac{\partial c}{\partial p_c} = \frac{\left\{-\mu w^2 - c\left[-\omega U_{SS} p_c + w\left(\omega_c U_S + \omega U_{Sc}\right)\right]\right\}}{|J|} \tag{8}$$

$$\frac{\partial c}{\partial w} = \frac{\left\{\mu w p_c + (24-S)\left[-\omega U_{SS} p_c + w\left(\omega_c U_S + \omega U_{Sc}\right)\right]\right\}}{|J|} \tag{9}$$

$$\frac{\partial S}{\partial p_c} = \frac{\left\{-\mu w p_c + c\left[-p_c\left(\omega_c U_S + \omega U_{Sc}\right) + w\left(2\omega_c U_c + \omega U_{cc}\right)\right]\right\}}{|J|} \tag{10}$$

In these expressions the first term of the numerators (i.e., the terms involving μ) captures the substitution effect, while the second terms captures the income effect of a price change. The income effect is modified relative to the standard income effect by the fact that one of the goods both enhances utility and reduces one's chance of survival.

Sufficient assumptions to meet the second order conditions are that the bracketed terms are $|J| > 0$, $A := \left[-p_c\left(\omega_c U_S + \omega U_{Sc}\right) + w\left(2\omega_c U_c + \omega U_{cc}\right)\right] < 0$ and $B := \left[-\omega U_{SS} p_c + w\left(\omega_c U_S + \omega U_{Sc}\right)\right] > 0$. These expressions are derived in the Appendix. Note that $B > 0$ implies that the income effect of a price change is negative in Equation (8). This ensures that the demand curve for cigarettes slopes downward. The condition, $B > 0$, also implies in Equation (9) that a rise in the wage will increase the consumption of cigarettes. In Equation (7), the assumption that $A < 0$ creates an ambiguity in the response to increments of endogenous social capital. The direct effect, $-\mu p_c^2 < 0$, results because the opportunity cost of S has increased, the substitution effect; the remaining portion arises because, ceteris paribus, income rises with the wage, the income effect. Thus we find that the choice to invest one's time in developing social capital may bring the result that endogenous social capital and cigarette consumption do not trade off.

There is a stronger reversal if the price of cigarettes were to rise. Via Equation (8) this parameter change results in lower cigarette consumption. We know empirically that cigarette demand is price inelastic; Sheu et al. (2004) find an elasticity of -0.46, while Gruber and Zinman (2002) estimate an elasticity for youth at -0.67. This implies that the individual's expenditures on cigarettes will rise when the price rises. By the budget constraint in Equation (5), this further implies that expenditures on social capital will fall.

Exogenous forms of social capital will exist and they will entail no comparable opportunity cost. For example, a family that has lived in the community for some time may find that their social network becomes more productive of utility if the city puts in a park or playground nearby. The effect is similar if a social club opens a franchise nearby. These enable social capital and constitute an exogenous form of social capital, which we identify as E.[1]

It is useful to contrast the case of the exogenous form, E. The fact that S has opportunity costs qualifies its effects, whereas E has a clear relationship to c

[1] A complicating factor can arise if the city park is decided by the subject's vote and/or tax payment. But a single individual will be small in comparison to the community and is virtually independent of the outcome. This issue may be more relevant at a higher ecological level.

and S. As before, the cross-partials needed for the comparative static results are provided in the Appendix. The incremental effects of E are given in Equations (11) and (12):

$$\frac{\partial c}{\partial E} = \frac{-w\left(\omega U_{SE} p_c - w\omega_c U_E\right)}{|J|} < 0, \tag{11}$$

$$\frac{\partial S}{\partial E} = \frac{p_c\left(\omega U_{SE} - w\omega_c U_E\right)}{|J|} > 0. \tag{12}$$

The results are clear. The fact that S and E are complements, $U_{SE} > 0$, and that E benefits utility, $U_E > 0$, are both required by the definitions of those terms. The result provides a useful contrast with the previous case. Where social capital is provided essentially as a public good the gains are unambiguous. Prime examples of exogenous social capital are social norms, when examined from the point of view of the individual subject who is too small in society to determine the norm. We note that while "norms" are somewhat nebulous and difficult to measure the concept is relevant to econometric analysis where such norms can be expected to differ between areas studied in panel and can be addressed as fixed effects.

Augmenting the model in two common ways will modify these results but are of doubtful importance. First we have omitted the possibility that $\Delta E > 0$ might increase the utility of smoking such as would be the case if $U_{cE} > 0$. This alternative would occur when there are Veblenesque effects, influences of popular public behavior on the individual's consumption. Becker and Murphy (2000) analyzed such effects for the case of general consumption goods. Does it apply to cigarettes? Some research suggests that such peer encouragement to smoke is especially important to youths, provided the youth's cohort smokes (Glaser, Shelton and van den Bree, 2010; Wilkinson et al. 2009; Stewart-Knox, 2005; Page, et al. 2006). However, growing into adulthood seems to both moderate the influence of peers as well as to increase the chance that one's peers favor quitting (Lee and Kahende, 2007; Sapag, 2010; Afifi, Nakhash, Khawaja, 2010). When treating adults, we have assumed that $U_{Ec} = 0$.

A second alternative worth considering is to augment the model with a composite, other consumer good. While making the model more realistic it will also make the predictions more ambiguous. This follows since inclusion of another good has two main effects. First, there are now three goods in the budget constraint. An increase in expenditures on the composite good would require a reduction in S and/or c. A reduction in S is intuitive because this means that the individual has increased work time to cover his larger expenses. Second, the presence of the composite good can also modify the relationship of S to cigarette consumption. One example helps to show this. Suppose the individual decides to seek a college degree, a pursuit that reduces work time, and via the budget constraint, may result in a reduction in cigarette consumption as well.

3 The Social Capital Variables and Hypotheses

The HUNT data we employ contains five social capital related variables. These and the other variables will be described fully in the Data section. But we

describe the five here to connect them to the model and to state the hypotheses for the empirical section. The focus specifically is on whether the variables are exogenous or endogenous. These are a priori expectations and we recommend them by which to interpret the estimates. However, the empirical analysis also offers a comparison of OLS versus instrumented versions of the estimates.

Community Trust: Some people are inherently more trusting than others. But trust of the community will ultimately be a perception of and response to a specific community at hand. The individual has only a modest influence over it, and s/he bears no monetary opportunity cost for it. Thus Community Trust will be exogenous and its increase will tend to reduce smoking in the individual.

Family variables, Cohabiting and Children: Certainly family has costs, both expenses and emotional investment. But in many cultures worklife is structured so that family time is a dedicated part of the day. There are many exceptions, but we propose that the main case has a regularity in which there are no direct opportunity costs in terms of earnings. In this sense, family variables are exogenous and increments will tend to reduce smoking. Child also interests us in that children neither seem to reduce stress nor provide health information. Their role appears to be to induce a sense of responsibility for the child (side stream smoke) and self responsibility to the parent.

Friends and Participation in Community Organizations. These characteristics will either compete with work time or family time. In either case the result is likely to be the same. There is an opportunity cost to each and these variables are endogenous. Because these variables operate on both the propensity to smoke and on the budget constraint their effects on smoking will be ambiguous.

Table 1 below summarizes the Hypotheses.

[Table 1 about here]

4 Data, Variables and Method

4.1 The Hunt Data

The HUNT surveys (Helseundersøkelsen i Nord-Trøndelag) of a region in Norway contain extensive individual data about health and health-risk factors.[2] The HUNT data provide information about self-rated quality of life and health, body weight and height, lifestyle factors (use of tobacco, alcohol and, physical activities), family-related social capital, living arrangement (coresident with spouse, partner, parents and children etc.), labour market status, occupation, job attributes and friends other community-level social capital attributes.

The HUNT data collection was done in three waves. The paper uses information compiled in HUNT 2 and HUNT 3.[3] HUNT 2 was conducted during 1995-97 and comprised 71.2 % of the population 20 years and older (66,140 persons) as well as 8,984 pupils aged 13-19. HUNT 3 was conducted from October 2006 to June 2008. All inhabitants in Nord-Trøndelag 13 years and older were invited to participate in HUNT 3. The overall response rate was about

[2] For more information about HUNT, see Holmen et al. (2003), and the HUNT website: http://www.ntnu.edu/hunt

[3] There were no social capital information contained in HUNT 1.

56%. The survey was constructed in the same way as the HUNT 2, but includes several other topics.

In total 55,629 individuals were responded only in HUNT 2 and 41,983 in HUNT 3. Among them 28,848 individuals participated in both HUNT 2 and HUNT 3; 26,781 people participated only in HUNT 2 but not in HUNT 3, and 13,135 individuals were responded only in HUNT 3 but not in HUNT 2. After dropping missing information on different covariates, our final analyses consist of 33,910 individuals in HUNT 2. In our data set some of the important socioeconomic information has been missing in HUNT 3, hence, we have used lags of some of the important covariates (e.g. education). Therefore, in analyzing HUNT 3, we have to use data on the individuals who participated in both HUNT 2 and HUNT 3. This provided a balanced panel and total 28,848 individuals. This methodology also facilitates us to use the lag of the variables that to be considered as the instruments of some endogenous variables, and may defend us from the threat of the endogeneity bias of the estimates. After dropping missing information on different covariates, in HUNT 3 our final analyses consist of 23,488 individuals.

4.2 Variables

4.2.1 Dependent Variable

Cigarettes is a dummy variable that takes the value of 1 if individual reports smoking cigarettes daily and 0 otherwise.

4.2.2 Independent variables

Social Capital

We consider five variables to be representative of social capital:

1. *friends*- The question was asked :"Do you have friends that you can speak to confidentially?" yes=1 and no=0 . This variable is available in both HUNT 2 and HUNT 3.

2. *co_trust*- individuals perception regarding community-level trust "people can't trust each other here"). This is a Likert scale with 1=strongly agree to 5=strongly disagree. We create a dummy variable where somewhat disagree or strongly disagree or not sure =1; somewhat agree or strongly agree =0. This question was asked in both HUNT 2 and HUNT 3.

3. (a) HUNT 2: *sos_part*[4]- whether individuals participated in different social activities. Specifically, the question was asked: 'How often do you usually participate in social activities such as a sewing club, athletic club, political association, religious or other groups? From the alternative answers, we construct a dummy variable where: 1-2 times a month/about once a week/More than once a week=1; never, or only a few times a year =0.

3. (b) HUNT 3: *part_org*[5]- whether individuals participated in an association or club meeting or participate in an activity. In particular

[4]The variable is only available in HUNT 2.
[5]The variable is only available in HUNT 3.

individuals were asked "How many times in the last 6 months have you participated in an association or club meeting/activity?" From the alternative answers, we construct a dichotomous variable where: more than 1 time per week or 1 time/month or 1-3 times/ month or 1-5 times/6 month =1 and never =0.

4. *cohabit-* cohabiting status of individuals: 1= living with spouse or partner; 0= living alone.

5. *child-* defined as whether individuals living with persons under the age of 18 years: yes=1; no=0.

Both cohabit and child variables are available in HUNT 2 and HUNT3.

Other Covariates

In the empirical analysis, we include a large number of control variables. In particular:

Female – is a dummy variable where women = 1, men = 0.

Age – is age (measured in years) at participation.

SES – Socioeconomic status (SES) may influence individuals' decision towards smoking or not. Therefore we control for education, income and childhood environment variables which may proxy for SES:

Education level is categorized into four levels and defined as:

educ1= 7 years primary school or less and considers as the omitted category

educ2= High school, intermediate school, vocational school, 1-2 years high school

educ3= University qualifying examination, junior college, A levels and

educ4= University or other post-secondary education, less than 4 years or University/college, 4 years or more

Income_prob– As a proxy for income, we include a dummy variable: income problems. Individuals were asked "During the last year, has it at any time been difficult to meet the costs of food, transportation, housing and such?" yes =0; no = 1. This variable may be a better measure of income rather than financial income which could influence individuals' attitude towards smoking decision.[6]

Workhour - and Work -

[6]In our data set, information on individuals' education is available only for HUNT 2, and question on 'income problems' was only asked in HUNT 2. While analyses HUNT 3, we use lag of these variables as proxy variables for these attributes.

a. Hunt 2: *Workhour*[7] - The question was asked: 'How many hours of paid work do you have a week?' As this information may be rather relevant in line with our theoretical prediction, however, this question is available only in HUNT 2.

b. Hunt 3: *Work*- the question was asked: 'Is your work so physically demanding that you are often physically worn out after a long day's work?' Yes, nearly always/Quite often/seldom/never, or almost never=1; Else/Not work=0. This information has been used as a proxy for the individuals' labor market status in analyzing data in HUNT 3.

Indoor_smoke – Moreover as an indicator of individuals' SES we include another variable to capture individuals' childhood environment, namely, indoor_smoke: "Did any of the adults where you grew up smoke indoors?" Yes =1; No = 0.

QoL – Quality of life of an individual may also influence individual decision whether to smoke and not. So we need to control for this attribute in the analysis. For doing so, we include individuals' self assessed quality of life (QoL) in the regression analyses. The question was asked: "Thinking about your life at the moment. would you say that you by and large are satisfied with life. or are you mostly dissatisfied? We categorized: Very satisfied/ Satisfied/ Somewhat satisfied=1; Neither satisfied nor dissatisfied/ somewhat dissatisfied/Dissatisfied/ Very dissatisfied=0"

BMI – We also control for individuals' body mass index (BMI) which also think to be influence individuals' smoking decision.

Table 2 provides the definitions and descriptive statistics of the variables used in the analyses.

[Table 2 about here]

4.3 Econometric Approach

The modelling of a dichotomous dependent variable - smoking participation decision - whether an individual smoke cigarettes daily or not - is modelled as a function of social capital and individuals' personal characteristics (age, gender, education, work status the presence of income problems, experience of indoor smoke, self assessed QoL, and BMI). Smoking participation for individual i then can be expressed:

$$c_{ijt} = \alpha + \mathbf{s}_{ijt}\beta + \mathbf{x}_{ijt}\delta + \varepsilon_{ijt}, \tag{13}$$

where, $i = 1, ..., n$, indicate the individuals; $j = 1, ..., M$, the municipalities; and $T = 1, 2$, the time periods.

In Equation (13) c_{ijt} is the smoking variable, $\mathbf{s}_{ijt}$ is the vector of the five social capital measures, $\mathbf{x}_{ijt}$ is the vector of personal characteristics, ε_{ijt} is the

[7]For some individuals we have missing information on this attribute, therefore we impute mean number of work hour if someone is engaged in a work and if not we impute zero for the number of work hour.

error term with mean zero and constant variance, and β and δ are the parameters to be estimated.

The smoking participation outcome within each municipality is likely to be correlated. To correct for this we further estimate the following municipality fixed effect model, where ϕ_j is Municipality j.

$$c_{ijt} = \alpha + \mathbf{s}_{ijt}\beta + \mathbf{x}_{ijt}\delta + \phi_j + \varepsilon_{ijt}. \tag{14}$$

The probability that, over the sample period, individual i currently smokes cigarettes, is given by: $prob\left(c_{ijt} = 1\right) = F\left(\mathbf{s}_{ijt}\beta + \mathbf{x}_{ijt}\delta\right)$, where $prob$ denotes probability, and $F\left(\cdot\right)$ is the Cumulative Distribution Function (CDF) of the standard normal distribution (assuming that the error term in this equation has a standard normal distribution) gives the probit model. The parameters are estimated by maximum likelihood. To compare with other models, the vectors of parameters have also been estimated using ordinary least squares (OLS) i.e. using linear probability models (LPM).

Standard OLS and probit estimates of the coefficients associated with c_{ijt} yield unbiased results if $\mathbf{E}\left(c_{ijt}\varepsilon_{ijt}\right) = 0$ holds. However, it is suspected that there are some specific reasons (mainly three) why the orthogonality condition could fail and prevent analysts from interpreting such a relationship as causal. First, it is typically difficult to distinguish the social capital effects from other local effects potentially influencing smoking decision. Second, social capital and smoking might both be linked to other characteristics of the individual, some of which may be observable and potentially controlled for, but others (such as individual motivation) may not be, which depend on individual specific and unobservable preferences. Hence, theoretically, social capital indicators may yield biased coefficients. Third, there is concern about possible reverse causality, that is, more smoking might lead to the accumulation of more or less social capital. For example, smoking individuals might have more or fewer friends, if their social milieu consists mainly of more or fewer smokers.

To handle the first problem we consider municipality fixed-effects by including municipality dummies in the regression analyses (Equation 14). Thus the fixed effects do double duty. To address the bias issues, we turn to instrumental variable (IV) estimates for social capital measures ($\mathbf{s}_{ijt}$). Notice that, in order for a variable, e.g. z, to serve as a valid instrument for s, the instrument must be exogenous i.e. $Cov(z, \varepsilon) = 0$, and the instrument must be correlated with the social capital variable s, i.e. $Cov(z, s) \neq 0$.

Finding a valid instrument is often a difficult task. The longitudinal (panel) data allow us to consider lagged social capital attributes. Following earlier work we use long lags as of social capital indicators as potential instruments. Longer lags offer a better instrument because a longer lag may reduce any correlation between the instrument and the disturbances in the error term of the original OLS regression (Hall, 1988; Yogo, 2004; Murrey, 2006). Moreover, potential reverse causality, that is, more smoking participation leading to the accumulation of lower lagged social capital may not an issue here. However, it is also expected that more distant lags are also more likely to be weakly correlated with the endogenous variable. Consequently, the validity of distant-lagged variable values as instruments has to be particularly convincing for such instrumental variable results to be trustworthy (Murrey, 2006).

In our analyses we consider a set of instruments for two indicators of social capital. These are namely: friends in previous wave, i.e. in HUNT 2

(*friend_96*), perception on the community likings (*co_like*)[8] and how regular an individual is in participating in music/singing during the last 6 months (*music*)[9]. Moreover, to handle endogeneity issues for other important control variables, e.g. education and income problem, we use lagged values of these attributes in our analyses.

Last but not least, the choice of using the IV estimations technique might be made on the basis of prior information; in particular, theory might tell us that the "orthogonality" assumption about a particular variable is not likely to be satisfied. It is a good practice indeed, to see if IV and OLS have different implications. For doing so we use a regression test for endogeneity though the use of an empirical testing of the assumption of no correlation indirectly, particularly, though the use of a Wu-Hausman test and Durbin (score) χ^2-test.

5 Results

5.1 OLS and Probit Estimates

Table 3 provides the estimates of alternative regression analyses on individuals' smoking decision participation with and without controlling municipality fixed effects.

[Table 3 about here]

As seen in Table 3, the OLS and probit marginal effects are found to be significantly associated with four of the social capital indicators. Though magnitudes of the coefficients are rather different depending on the HUNT waves (i.e. HUNT 2 or HUNT 3), the signs of the coefficients are the same in the alternative waves. The associations seem to be higher and stronger for the social capital attributes, such as friend (*friends*) and social participation (*soc_part*) in HUNT 2. Regression results based on HUNT 2 shows that having a close friend is positively and significantly associated with smoking participation at 1 per cent level. The corresponding variables in HUNT 3- participation in different organization (*part_org*) is found significant at the 1 per cent level and friend (*friends*) is found significant only at the 10 per cent level and with lesser magnitude. Regardless of the waves, the cohabiting status (*cohabit*) seems significantly and negatively (with similar magnitude) associated with individuals' cigarettes smoking participation. Having a child (*child*) in the family appears significantly to reduce the likelihood of cigarette smoking, however, the effect of this attribute of family related social capital is more pronounce in the latest wave of HUNT than the earlier wave. The perception of community trust (*co_trust*) is negatively related with the individual decision towards cigarette smoking, though found insignificant in both waves[10].

[8] The question was: People like living here? 1 =strongly agree to 5=strongly disagree; we constructed as: somewhat agree or strongly agree =1; not sure/ somewhat disagree or strongly disagree=0.

[9] The question was: how many times in the last six months have you participated in music/singing/ theatre? We constructed as the variable music as: if individual participated sometime in a week/month=1; or Never=0).

[10] Notice that in the *co_trust* variable, while including 'not sure=0, we have found similar results as well.

In HUNT 2, *workhour* is found positively and significant associated with smoking participation, however, individuals' labour market status (i.e. *work*) does not have any significant association with smoking decision as found in HUNT 3.

Other covariates are found to be associated with the smoking participation decision with expected signs. In particular, the likelihood of cigarette smoking is lower for those who are female or aged, those with a higher level of education and those having no income problem during last year and with a better quality of life. In contrast, if an individual grew up in a household where adults smoke indoors, this is positively associated with higher likelihood of smoking participation. Finally, we find that better self-assessed quality of life (QoL) and higher BMI is significantly associated with lower smoking participation in both HUNT 2 and HUNT 3, and with similar magnitudes of the coefficients.

5.2 Instrumental Variable (IV) Estimates

As discussed earlier, these observed associations between S and smoking participation may not be causal. Therefore, we further analyze the relationship using IV estimation techniques. Table 4 highlights the results of two alternative IV estimation approaches- 2 Stages Least Square (2SLS) and Generalized Method of Moments (GMM). Notice that, if we do include all three non-family related S indicators in a single regression model, we have to have at least three instruments, and if all three instruments are not correlated with the S indicators they may produce invalid estimates. To avoid such difficulty in the IV estimation procedures in our models social capital measures are estimated individually, but all models have controlled for exogenous social capital (family related social capital), the socio-demographics and QoL measures. Ideally we would like to instrument the family social capital variables too. Unfortunately we lack data to perform this procedure, see also below.

When we address the endogeneity of the three non-family social capital indicators by using 2SLS and GMM techniques, friend has a positive effect on cigarettes smoking decision as previous, but is statistically insignificant. The magnitude of these coefficient (and standard errors) associated with the indicator varies substantially as well. However, as with OLS and probit estimates, irrespective of whether with or without municipality fixed effects, participation in various organizations (part_org) is found negatively and highly significantly effect smoking participation. The magnitude of the effect is also similar with the OLS estimates. IV estimates show that the probability of smoking participation reduces by around 6 percent (around 4 per cent for the OLS estimates) if individuals participated in association or club meeting or activities.

[Table 4 about here]

Nevertheless, questions could be asked about whether our instruments are reasonable and valid so that we can rely on these quantitative estimates of the effects. The diagnostic tests for our instruments are provided in Table 4. As seen in Table 4 that all of the first stage summary statistics illustrate that our instruments are reasonably strong. Particularly, our instruments are passed the criterion as suggested by Staiger and Stock (1997) as the rule of thumb criterion

of instrument weakness. The criterion indicates that the F-statistics- testing the hypothesis that the coefficients on the excluded instruments are all zero in each first-stage estimate are well above the threshold of 10.

The second condition for IVs is that the instruments must be uncorrelated with the structural error term. If the model is just identified, then we cannot perform a test of over-identifying restrictions. If the model is over-identified, then we can test whether the instruments are uncorrelated with the error term. By including an additional instrument, namely, lag of close friend (*friend_96*) with every specification, we fit the models with heteroskedasticity-robust standard errors, and then we obtain Wooldridge's score test of over-identifying restrictions, which is robust to heteroskedasticity (see notes under table 6). The non-rejection of the test of over-identification suggests that our set of instruments is reasonable and valid.

Finally, based on Wu-Hausman test and Durbin (score) χ^2-test of endogeniety, for three of our social capital indicators reveal that the variables are, in fact, exogenous. The GMM C statistic found to be insignificant for these three social capital indicators as well.[11]

As described earlier that the family related social capital variables, *cohabit* and *child*, are both significantly take the negative sign and thus support the hypotheses. In both cases, however, we lacked the data for instrumental variables estimation. Thus the estimates do not encourage as strong inferences. We have argued on a priori grounds that cohabit is exogenous. However, a counter hypothesis often stated is that the sorting process before marriage may select for characteristics some of which may be related to future smoking behavior. The share of influence between the two is not proven.

Burt (2010) studied longitudinally the behavior of young men prior to and after marriage. Of unmarried men, those who would become married showed the lesser antisocial behavior. Once married, their antisocial behaviors again declined. Clearly both the selection process of marriage and the adaptation process of marriage contributed to the improvement. In Burt's data, the influences were split roughly equally.

Likewise we have proposed on a priori grounds that having a child is exogenous to choosing to smoke. But having a child raises a different and interesting question. Why do parents smoke less? On one hand, they may wish to avoid providing side stream smoke to the child. Yet, some report that smokers commonly step outside to smoke. On the other hand, a parent with children feels responsible to the children and by implication more responsible regarding his or her own risk of death. This is suggested in data studied by Deleire and Levy (2004). They found that single mothers were less likely to take jobs with a risk of death than single women generally. The relationship of having children and smoking, clearly negative in Table 3, probably has elements of both self-selection and adaptation.

6 Conclusions

In this paper, we have presented a model that seems appropriate to capture the social capital ideas discussed in the noneconomic literature. Two features are noteworthy. One, it depicts, realistically, that many kinds of activity that are

[11] Participation in community organizations is not exogenous at the 10% level.

frequently called social capital require the expenditure of time and thus have an opportunity cost. Thus if the individual's wage were to rise, its effect would occur in two parts: an income effect and a substitution effect. The net effect is ambiguous. Further, social capital and cigarette consumption do not necessarily appear to trade off in this case.

Two, the model contrasts exogenous and endogenous social capital, and it suggests cases for each. Exogenous types are those that require little or no time or energy to acquire. Without opportunity costs, their insertion into the community has uncomplicated benefits to the individual. This latter case is similar to the common treatment of social capital and health in the noneconomic literature.

To test these ideas econometrically, we contrast our five social capital variables by our conjectured degree of exogeneity. We argued that trust, cohabit and child are exogenous, however, we also instrumented *co_ trust* to compare. We lacked the data to instrument cohabit and child. Nevertheless our instrumental variables use in these three instances is relatively new to this literature.

We use a substantial Norwegian longitudinal data set - the HUNT Data to test our predictions. Our results based on OLS and probit show that the likelihood if the individual's smoking participation is negatively associated with participation in organizations, community trust, cohabitation and having children. To interpret these relationships as causal, we test and try to tackle the endogeneity problem in different social capital indicators by using instrumental variable (IV) techniques. For the three variables to which IV estimates were applied, the negative and significant impact of social capital is found only for two of its characteristics - participation in different organization and community trust„ though the latter variable just significant at the 10% level. Two additional social capital variables, cohabitation and children, also entered significantly and negative. We have reasoned that these variables are exogenous in principle, but unlike the others we were not able to develop IV methods for them and we could not test this assumption.

Nevertheless, the results of the endogeneity tests reveal that our social capital variables, friend, community trust and participation in community organizations indeed exogenous. Since IV estimations, particularly 2SLS estimator is less efficient than OLS when the explanatory variables are exogenous (Wooldridge, 2002), we should focus on the OLS estimates. Our overall conclusion is that the individual's smoking decision for the Norwegian population studied is modified beneficially by attributes of social capital.

Our study suggests ideas for future research. The model works because cigarette consumption reduces the probability of survival, it applies to others health risky behaviors such as consumption of heroin, crack cocaine, ecstasy, as well as obesity. Also, Friends and Participation in the Community may operate through peer effects and methods of studying peers effects may be applied. We have offered that perhaps several kinds of social capital have opportunity costs and they might be compared with public projects that enable social capital.

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7 Appendix

In this appendix we derive the expressions in equations $(7-10)$.

From the First-Order Conditions we obtain

$$\begin{aligned}
\mathcal{L}_{SS} &= \omega U_{SS} \\
\mathcal{L}_{Sc} &= \omega U_{Sc} + \omega_c U_S \\
\mathcal{L}_{\mu S} &= -w \\
\mathcal{L}_{cc} &= 2\omega_c U_c + \omega U_{cc} \\
\mathcal{L}_{c\mu} &= -p_c \\
\mathcal{L}_{\mu p_c} &= -c \\
\mathcal{L}_{\mu w} &= 24 - S \\
\mathcal{L}_{Sw} &= \mathcal{L}_{cp_c} = -\mu \\
\mathcal{L}_{\mu\mu} &= \mathcal{L}_{cw} = \mathcal{L}_{Sp_c} = 0.
\end{aligned}$$

The Second-Order sufficient conditions for a maximum requires that the bordered Hessian:

$$|H| := \begin{vmatrix} 0 & p_c & w \\ p_c & 2\omega_c U_c + \omega U_{cc} & \omega U_{Sc} + \omega_c U_S \\ w & \omega U_{Sc} + \omega_c U_S & \omega U_{SS} \end{vmatrix} > 0.$$

Hence,

$$\begin{aligned}
&w\left[p_c\left(\omega U_{Sc} + \omega_c U_S\right) - w\left(2\omega_c U_c + \omega U_{cc}\right)\right] - p_c\left[p_c \omega U_{SS} - w\left(\omega U_{Sc} + \omega_c U_S\right)\right] \\
&= 2p_c w\left(\omega U_{Sc} + \omega_c U_S\right) - w^2\left(2\omega_c U_c + \omega U_{cc}\right) - p_c^2 \omega U_{SS} > 0 \\
&= 2p_c w \mathcal{L}_{Sc} - w^2 \mathcal{L}_{cc} - p_c^2 \mathcal{L}_{SS} > 0.
\end{aligned}$$

Since $U_{Sc} < 0$, $\omega_c < 0$, $U_c > 0$, $U_{cc} < 0$, and $U_{SS} < 0$, the Second-Order sufficient condition for a maximum requires that the absolute value of $\mathcal{L}_{Sc}$, $|\mathcal{L}_{Sc}|$ is not too large.[12]

To find the comparative static effects expressed in equations $(7-10)$ we use Cramer's rule. Define

$$\begin{aligned}
F^1(\mu, c, S; p_c, w, E) &:= w(24 - S) - p_c c = 0 \\
F^2(\mu, c, S; p_c, w, E) &:= \omega_c U(\cdot) + \omega U_c - \mu p_c = 0 \\
F^3(\mu, c, S; p_c, w, E) &:= \omega U_S - \mu w = 0
\end{aligned}$$

Hence, we obtain the standard result that the endogenous-variable Jacobian determinant is identical with the bordered Hessian, i.e.,

$$|J| = \begin{vmatrix} 0 & -p_c & -w \\ -p_c & 2\omega_c U_c + \omega U_{cc} & \omega U_{Sc} + \omega_c U_S \\ -w & \omega U_{Sc} + \omega_c U_S & \omega U_{SS} \end{vmatrix} = |H| > 0.$$

[12] The exact condition is that $|\mathcal{L}_{Sc}| < \left|\frac{w^2 \mathcal{L}_{cc} + p_c^2 \mathcal{L}_{SS}}{2p_c w}\right|$.

Since $-\partial F^1/\partial w = -(24-S)$, $-\partial F^2/\partial w = 0$, and $-\partial F^3/\partial w = \mu$ we obtain

$$\begin{aligned}\frac{\partial S}{\partial w} &= \frac{1}{|J|}\begin{vmatrix} 0 & -p_c & -(24-S) \\ -p_c & 2\omega_c U_c + \omega U_{cc} & 0 \\ -w & \omega U_{Sc} + \omega_c U_S & \mu \end{vmatrix} \\ &= \frac{1}{|J|} \times \left\{-p_c^2\mu - (24-S)\left[w\left(2\omega_c U_c + \omega U_{cc}\right) - p_c\left(\omega U_{Sc} + \omega_c U_S\right)\right]\right\} \\ &= \frac{1}{|J|} \times \left\{-p_c^2\mu - (24-S)\left[\omega\left(wU_{cc} - p_c U_{Sc}\right) + \omega_c\left(2wU_c - p_c U_S\right)\right]\right\}\end{aligned}$$

In this expression $-p_c^2\mu$ is the substitution effect, and $-(24-S)\left[\omega\left(wU_{cc} - p_c U_{Sc}\right) + \omega_c\left(2wU_c - p_c U_S\right)\right]$ is the income effect. Note that the the "standard" income effect is obtained with $\omega = 1$, and $\omega_c = 0$.

To calculate $\partial c/\partial p_c$, note that $-\partial F^1/\partial p_c = c$, $-\partial F^2/\partial p_c = \mu$, and $-\partial F^3/\partial p_c = 0$. Hence

$$\begin{aligned}\frac{\partial c}{\partial p_c} &= \frac{1}{|J|}\begin{vmatrix} 0 & c & -w \\ -p_c & \mu & \omega U_{Sc} + \omega_c U_S \\ -w & 0 & \omega U_{SS} \end{vmatrix} \\ &= \frac{1}{|J|}\left\{-\mu w^2 - c\left[-\omega U_{SS} p_c + w\left(\omega_c U_S + \omega U_{Sc}\right)\right]\right\}.\end{aligned}$$

To find $\partial c/\partial w$, note that $-\partial F^1/\partial w = -(24-S)$, $-\partial F^2/\partial w = 0$, and $-\partial F^3/\partial w = \mu$. Hence

$$\begin{aligned}\frac{\partial c}{\partial w} &= \frac{1}{|J|}\begin{vmatrix} 0 & -(24-S) & -w \\ -p_c & 0 & \omega U_{Sc} + \omega_c U_S \\ -w & \mu & \omega U_{SS} \end{vmatrix} \\ &= \frac{1}{|J|}\left\{\mu w p_c + (24-S)\left[-\omega U_{SS} p_c + w\left(\omega_c U_S + \omega U_{Sc}\right)\right]\right\}.\end{aligned}$$

Finally, it follows that $\partial S/\partial p_c$ is

$$\begin{aligned}\frac{\partial S}{\partial p_c} &= \frac{1}{|J|}\begin{vmatrix} 0 & -p_c & c \\ -p_c & 2\omega_c U_c + \omega U_{cc} & \mu \\ -w & \omega U_{Sc} + \omega_c U_S & 0 \end{vmatrix} \\ &= \frac{1}{|J|}\left\{-\mu w p_c + c\left[-p_c\left(\omega_c U_S + \omega U_{Sc}\right) + w\left(2\omega_c U_c + \omega U_{cc}\right)\right]\right\}.\end{aligned}$$

We now calculate the incremental effects of E stated in equation (11 − 12). Since $U = U(S, E, c)$ we get $-\partial F^1/\partial E = 0$, $-\partial F^2/\partial E = -\omega_c U_E$, and $-\partial F^3/\partial E = -\omega U_{SE}$. Hence

$$\begin{aligned}\frac{\partial c}{\partial E} &= \frac{1}{|J|}\begin{vmatrix} 0 & 0 & -w \\ -p_c & -\omega_c U_E & \omega U_{Sc} + \omega_c U_S \\ -w & -\omega U_{SE} & \omega U_{SS} \end{vmatrix} \\ &= \frac{1}{|J|} - w\left[p_c \omega U_{SE} - w\omega_c U_E\right] < 0.\end{aligned}$$

Furthermore,

$$\begin{aligned}\frac{\partial c}{\partial E} &= \frac{1}{|J|}\begin{vmatrix} 0 & -p_c & 0 \\ -p_c & 2\omega_c U_c + \omega U_{cc} & -\omega_c U_E \\ -w & \omega U_{Sc} + \omega_c U_S & -\omega U_{SE} \end{vmatrix} \\ &= \frac{1}{|J|} p_c \left[p_c \omega U_{SE} - w \omega_c U_E \right] > 0.\end{aligned}$$

Table 1: The Social Capital Variables and Their Hypotheses

Exogenous Social Capital

1. Community Trust

Hypothesis 1: Increased trust in the community will influence the individual to reduce smoking.

2. Cohabiting: lives with spouse or partner.

Hypothesis 2: The presence of spouse or partner will influence the individual to reduce smoking.

3. Children

Hypothesis 3: The presence of children in the family will influence the individual to reduce smoking.

Endogenous Social Capital

4. Participation in the community.

Hypothesis 4: Participation in the community will have an ambiguous influence on the individual regarding smoking.

5. Friends and acquaintances.

Hypothesis 5: More friends and acquaintances will have an ambiguous influence on the individual regarding smoking.

Table 2: Definitions and descriptive statistics of the variables used in the analyses

Name of the variable	**Definition of the Variable**	HUNT 2 (N=33,910)		HUNT 3(N=23,488)	
		Mean/pro	Std. Dev	Mean/pro	Std. Dev
cigaeartes	Smokes cigarettes daily: yes = 1. else =0	0.3103	0.4626	0.1806	0.3847
friend	Do you have friends that you can speak to confidentially? Yes =1; No = 0	0.9680	0.1760	0.9128	0.2822
co_trust	People can't trust each other here; This is a Likert scale with 1=strongly agree to 5=strongly disagree; Somewhat disagree or strongly disagree=1; Somewhat agree or strongly agree or not sure=0	0.8286	0.3769	0.8145	0.3887
soc_part±	How often do you usually participate in social activities such as a sewing club, athletic club, political association, religious or other groups? 1-2 times a month/About once a week/More than once a week=1 Never, or only a few times a year =0	0.5864	0.4925	NA	
part_org§	"How many times in the last 6 months have you participated in an association or club meeting/activity?" More than 1 time per week or 1 time/week or 1-3 times/ month or 1-5 times/6 month =1; Never =0	NA		0.5199	0.4996
cohabit	1 = living with spouse or partner 0= living alone.	0.9277	0.2591	0.8254	0.3796
child	Live with the persons under the age of 18 years? Yes=1 ; No=0	0.4601	0.4984	0.2070	0.4051
Workhour±	How many hours of paid work do you have a week?	25.834	16.598	NA	NA
work	Is your work so physically demanding that you are often physically worn out after a long day's work? Yes, nearly always/Quite often/Seldom/Never. or almost never=1; Else/Not work=0	_	_	0.7406	0.4383
income_prob	During the last year, has it at any time been difficult to meet the costs of food, transportation, housing and such?" Yes =0; No = 1	0.8564	0.3507	0.8752	0.3305
age	Age at participation	44.816	12.534	57.007	11.877
sex	female= 1; male = 0	0.4586	0.4983	0.4363	0.4959
educ1	7 years primary school or less (Omitted category)	0.2880	0.4529	0.2824	0.4502
educ2	High school, intermediate school, vocational school, 1-2 years high school	0.3762	0.4844	0.3792	0.4852
educ3	University qualifying examination, junior college, A levels	0.1004	0.3005	0.0939	0.2917
educ4	University or other post-secondary education. less than 4 years or University/college. 4 years or more	0.2354	0.4243	0.2444	0.4298
indoor_smoke	"Did any of the adults where you grew up smoke indoors?" Yes =1; No = 0	0.6836	0.4651	0.6878	0.4634
QoL	Thinking about your life at the moment, would you say that you by and large are satisfied with life, or are you mostly dissatisfied? Very satisfied/ Satisfied/ Somewhat satisfied=1; Neither satisfied nor dissatisfied/ somewhat dissatisfied/Dissatisfied/ Very dissatisfied=0	0.8403	0.3664	0.8830	0.3214
bmi	Body Mass Index	26.188	3.962	27.357	4.2705

Note: ± the information is available only in HUNT 2. §only asked in HUNT 3.

Table 3: Smoking participation and social capital: OLS (LPM) and Probit estimates HUNT 2 and HUNT 3

Covariates	HUNT 2 (N=33910)				HUNT 3 (N=23.488)			
	OLS		PROBIT (marginal effects)		OLS		PROBIT (marginal effects)	
	Without municipality fixed effects	With municipality fixed effects	Without municipality fixed effects	With municipality fixed effects	Without municipality fixed effects	With municipality fixed effects	Without municipality fixed effects	With municipality fixed effects
friend	0.0406*** (0.0138)	0.0404*** (0.0138)	0.0395*** (0.0138)	0.0397*** (0.0138)	0.0149* (0.0088)	0.0158* (0.0088)	0.0146* (0.0085)	0.0158* (0.0088)
co_trust	-0.0077 (0.0067)	-0.0091 (0.0067)	-0.0085 (0.0054)	-0.0099 (0.0067)	-0.0107 (0.0067)	-0.0102 (0.0067)	-0.0110* (0.0064)	-0.0102 (0.0067)
soc_part	-0.0809*** (0.0052)	-0.0804*** (0.0052)	-0.0844*** (0.0054)	-0.0842*** (0.0054)	NA			
Part_org	NA				-0.0438*** (0.0050)	-0.0435*** (0.0050)	-0.0441*** (0.0050)	-0.0435*** (0.0050)
cohabit	-0.0319*** (0.0099)	-0.0304*** (0.0099)	-0.0332*** (0.0103)	-0.0316*** (0.0103)	-0.0354*** (0.0071)	-0.0359*** (0.0071)	-0.0353*** (0.0069)	-0.0359*** (0.0070)
child	-0.0110** (0.0056)	-0.0097* (0.0056)	-0.0117** (0.0059)	-0.0105* (0.0059)	-0.0462*** (0.0069)	-0.0458*** (0.0069)	-0.0451 (0.0066)	-0.0458*** (0.0070)
Workhour	0.0006*** (0.0002)	0.0006*** (0.0002)	0.0006*** (0.0002)	0.0006*** (0.0002)	NA			
Work	NA				0.0076 (0.0076)	0.0069 (0.0076)	0.0076 (0.0072)	0.0069 (0.0076)
income_prob	-0.1538 (0.0077)	-0.1521*** (0.0077)	-0.1561*** (0.0081)	-0.1548*** (0.0080)	-0.1225*** (0.0089)	-0.1227*** (0.0073)	-0.1174*** (0.0088)	-0.1227*** (0.0089)
age	-0.0009*** (0.0002)	-0.0009 (0.0002)	-0.0009*** (0.0003)	-0.0009*** (0.0003)	-0.0012*** (0.0003)	-0.0012*** (0.0003)	-0.0010*** (0.0003)	-0.0012*** (0.0003)
sex	-0.0480*** (0.0052)	-0.0461*** (0.0052)	-0.0502*** (0.0054)	-0.0483*** (0.0055)	-0.0390*** (0.0049)	-0.0390*** (0.0050)	-0.0392 (0.0050)	-0.0389*** (0.0050)
educ2	-0.0442*** (0.0067)	-0.0457*** (0.0067)	-0.0420*** (0.0065)	-0.0438*** (0.0065)	-0.0277*** (0.0071)	-0.0272*** (0.0071)	-0.0232*** (0.0061)	-0.0272*** (0.0071)
educ3	-0.1415 (0.0098)	-0.1453*** (0.0098)	-0.1278*** (0.0082)	-0.1313*** (0.0081)	-0.0850*** (0.0101)	-0.0851*** (0.0102)	-0.0693*** (0.0076)	-0.0851*** (0.0102)
educ4	-0.1955*** (0.0072)	-0.1996*** (0.0073)	-0.1909*** (0.0064)	-0.1944*** (0.0064)	-0.1288*** (0.0072)	-0.1283*** (0.0073)	-0.1203*** (0.0058)	-0.1283*** (0.0073)
indoor_smoke	0.1090*** (0.0050)	0.1072*** (0.0050)	0.1141*** (0.0052)	0.1141*** (0.0052)	0.0635*** (0.0050)	0.0617 (0.0050)	0.0639*** (0.0050)	0.0617*** (0.0050)
QoL	-0.0643*** (0.0071)	-0.0642*** (0.0070)	-0.0665*** (0.0074)	-0.0667*** (0.0074)	-0.0632*** (0.0086)	-0.0623*** (0.0086)	-0.0601*** (0.0085)	-0.0623*** (0.0086)
bmi	-0.0124*** (0.0006)	-0.0122*** (0.0006)	-0.0128*** (0.0007)	-0.0126*** (0.0007)	-0.0079*** (0.0006)	-0.0080*** (0.0006)	-0.0075*** (0.0006)	-0.0080*** (0.0006)

Note: Robust standard errors are in the parentheses. '***', '**' and '*' indicates significance level at the 1%, 5% and 10% respectively.

Table 4: Smoking participation and social capital: Instrumental Variables (IV) estimates based on HUNT 3[¥]

Variable	2SLS Estimates		GMM Estimates	
	Without municipality fixed-effects	With municipality fixed-effects	Without municipality fixed-effects	With municipality fixed-effects
friend[§]	0.0498 (0.0447)	0.0589 (0.0449)	0.0496 (0.0447)	0.0589 (0.0449)
Instrumental variables diagnostics	First-stage: Adjusted R^2= 0.0740 F =199.66 Test of overidentifying restrictions: score χ^2 ; p=0.8942 Test of endogeneity: Durbin (score) χ^2 (p = 0.377); Wu-Hausman F (p = 0.377)	First-stage: Adjusted R^2=0.0753 F= 199.33 Test of overidentifying restrictions: score χ^2 ; p=0.8461 Test of endogeneity: Durbin (score) χ^2 (p = 0.297); Wu-Hausman F (p =0.297)	F First-stage: Adjusted R^2= 0.0740 F =199.66 Test of overidentifying restrictions: score χ^2 ; p=0.8942 Test of endogeneity: GMM C statistic (p = 0.379)	First-stage: Adjusted R^2=0.0753 F= 199.33 Test of overidentifying restrictions: score χ^2 ; p=0.8461 Test of endogeneity: GMM C statistic (p = 0.299)
co_trust[€]	-0.0795* (0.0464)	-0.0738 (0.0468)	-0.0792* (0.0464)	-0.0733 (0.0468)
	First-stage: Adjusted R^2= 0.0456 F =184.13 Test of overidentifying restrictions: score χ^2 ; p=0.377 Test of endogeneity: Durbin (score) χ^2 (p = 0.135); Wu-Hausman F (p = 0.135)	First-stage: Adjusted R^2=0.0468 F= 179.52 Test of overidentifying restrictions: score χ^2 ; p=0.337 Test of endogeneity: Durbin (score) χ^2 (p = 0.174); Wu-Hausman F (p =0.174)	First-stage: Adjusted R^2= 0.0456 F =184.13 Test of overidentifying restrictions: score χ^2 ; p=0.377 Test of endogeneity: GMM C statistic (p = 0.137)	First-stage: Adjusted R^2=0.0468 F= 179.52 Test of overidentifying restrictions: score χ^2 ; p=0.3365 Test of endogeneity: GMM C statistic (p = 0.177)
part_org[±]	**-0.0663***** **(0.0141)**	**-0.0671***** **(0.0142)**	**-0.0667***** **(0.0142)**	**-0.0676***** **(0.0142)**
Instrumental variables diagnostics	First-stage: Adjusted R^2=0.1500 F= 1724.1 Test of overidentifying restrictions: score χ^2 ; (p = 0.1999) Test of endogeneity: Durbin (score) χ^2 (p = 0.0811); Wu-Hausman F (p = 0.0811)	First-stage: Adjusted R^2=0.1521 F= 1701.75 Test of overidentifying restrictions: score χ^2 ; (p = 0.1662) Test of endogeneity: Durbin (score) χ^2 (p = 0.0669); Wu-Hausman F (p = 0.0669)	First-stage: Adjusted R^2=0.1500 F= 1724.1 Test of overidentifying restrictions: score χ^2 ; (p = 0.1999) Test of endogeneity: GMM C statistic (p = 0.0751)	First-stage: Adjusted R^2=0.1521 F= 1701.75 Test of overidentifying restrictions: Hansen's J (p = 0.1662) Test of endogeneity: GMM C statistic p = 0.0614)

Note: Robust standard errors are in the parentheses. '***' '**' and '*' indicates significance level at the 1%. 5% and 10% respectively.

[¥] Social capital measures are estimated individually and all models are controlled for the socio-demographics and health measures, i.e. variables included in Table 2.

[§]Instruments: friends in 1996 and perception on the community likings: co_like (People like living here; 1 =strongly agree to 5=strongly disagree; somewhat agree or strongly agree =1; not sure/ somewhat disagree or strongly disagree=0;

[€] Instruments used are friends in 1996 and co_trust in 1996.

[±] Instruments used are friends in 1996 and how frequent individual has participated in music (music).

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