Neighbourhood social capital and individual mental health

Tampubolon, Gindo
Institute for Social Change, University of Manchester

13. August 2009

Neighbourhood social capital and individual mental health

Gindo Tampubolon*

August 13, 2009

Abstract

Neighbourhood social capital is often claimed beneficial for health, yet evidence of this contextual effect in the UK has been thin. To examine this effect, I draw upon Grossman health production model and Blume-Brock-Durlauf social interaction model underpinning the effects of neighbourhood social capital on individual health. This study uses two most recent independent surveys on neighbourhood social capital and on individual mental health in Wales. Both are linked based on neighbourhood. I find that many forms of neighbourhood

*Institute for Social Change, University of Manchester, g.tampubolon@manchester.ac.uk. I thank the Welsh Assembly Government – Llywodraeth Cynulliad Cymru – for funding this work. Data used in this analysis are provided by the Government under contract designed to protect the anonymity of respondents and neighbourhoods. They are not available from the author. Ichiro Kawachi and Subu Subramanian have been especially generous with their ideas for which I am grateful.

social capital, measured with widely used questions, improve resident's mental health (SF36). Public health practitioners have these measures as additional tools to draw upon in formulating public health policy.

Keywords: social capital, SF36, quality of life
JEL: I12, I18, D71, Z13
Prepared for The Economic Journal

Claim that social capital matters seems intuitive; yet supporting evidence remains elusive. Studies in the US show that neighbourhood social capital correlates with individual health (Kawachi *et al.*, 1997, 1999; Subramanian *et al.*, 2005; Viswanath *et al.*, 2006; Farquhar *et al.*, 2005; Perry *et al.*, 2008). In the UK however comparable evidence is difficult to find (Duncan *et al.*, 1993; Sloggett and Joshi, 1998; Mohan *et al.*, 2005; Propper *et al.*, 2005; Stafford *et al.*, 2008). Studies from other countries such as New Zealand and Sweden have failed to settle the issue (Blakely *et al.*, 2006; Islam *et al.*, 2006). The claim still retains its appeal.

Kawachi and Berkman (2003) clarify the mechanisms relating neighbourhood social capital and individual health. First, more cohesive groups are better equipped to disseminate information and mobilize collective action such as preventing the excursion of fast food outlets through the use of zoning restriction. Second, more cohesive groups are better equipped to maintain social norms, hence maintain residents' sense of health. Though social

norms can also influence health in negative ways as shown in the case of obesity (Christakis and Fowler, 2007). The last mechanism is indirect; collective efficacy and informal control in preventing crime and violence, in turn, reduce residents' exposure to daily environmental stresses and insults.

Despite these mechanisms, gaps remain in the literature. Studies on social capital and health fail to connect with theoretical model of health production, particularly Grossman health model (Grossman, 1972b,a), thereby depriving them of formal grounding. Conversely, health economics studies following Grossman's ignore the potential of neighbourhood social capital in influencing individual health decisions. How neighbourhood social capital produces health quality of life among residents is left unspecified.

Moreover, previous studies of social capital and health outcome have relied upon residents' reports of their neighbourhood social environment. The assessment of social capital was obtained from the same residents whose health outcomes were measured. This raises reflection problem potentially preventing identification (Manski, 1993). Next, the level of spatial aggregation to define 'neighbourhoods' has varied across previous studies. For example, studies in the UK, admittedly by necessity rather than by design, tend to use the administrative wards to define 'neighbourhoods' – which many consider to be rather heterogeneous for studying the impact of neighbourhood social environments on health decisions. Finally, rarely does a study on social capital examine its effect on health outcome measured using widely validated health instrument.

The few existing studies of social capital and health in the UK failed to find a general association between social capital and health outcomes (Duncan *et al.*, 1993; Sloggett and Joshi, 1998; Mohan *et al.*, 2005; Propper *et al.*, 2005; Stafford *et al.*, 2008). The nearest to find a negative effect of neighbourhood social capital on individual mental health is a study by Stafford *et al.* (2008). They report a negative association (p. 304)"between social capital and common mental disorders which was limited to economically 'stressed' residents and neighbourhoods."

I first propose an extension to the influential Grossman model of health (Grossman, 1972b,a). The extended model elaborates on social interactions and their effects on individual decisions, particularly health maintenance and health risk decisions. I shall draw upon the Blume-Brock-Durlauf social interaction model (Blume, 1993; Brock, 1993; Durlauf, 1997; Brock and Durlauf, 2001a,b; Durlauf, 2002; Blume and Durlauf, 2005).

Thus recent scholarships in public health, epidemiology, and economics are used to augment this influential model with neighbourhood effects. Instruments or exclusion restrictions that are theoretically motivated within the extended Grossman model are readily obtained. Also, the neighbourhood is defined as the local super output area, a geography purposefully designed for social research, and comprising about 500 households. This standardised geography enables independent measures of neighbourhood social capital and neighbourhood deprivation, obtained from administrative sources, to be used. Of equal importance, a widely validated instrument of

health related quality of life, SF36, is used to measure mental health (Ware, 2004; Wilkin *et al.*, 1992).

1 Neighbourhood social capital and health

Social capital is a crystallisation of the ideas that have been around since researchers began to examine systematically the relationships between society, especially neighbourhood, and individual health. A definition that will suffice for our purpose is due to Putnam (1993): "social networks and norms and trustworthiness" residing in a neighbourhood. It is obvious that social networks, norms and trust grow out of and circulate in social interactions; see also the discussion by Woolcock (1998). The literature on social interactions model will be one of the main sources of modelling ideas drawn upon in this study.

Recent works in social epidemiology have attempted to be more specific about how social capital influences health and well being Berkman and Kawachi (2000); Kawachi and Berkman (2003). Kawachi and Berkman write about mechanisms linking neighbourhood social capital and individual health. First, more cohesive groups are better equipped to mobilize collective action and distribute information. Second, more cohesive groups are better equipped to enforce and maintain social norms. It is now recognised that social norms can also influence health in negative ways. Lastly, collective efficacy and informal control in preventing crime and violence, in turn, reduce

environmental stresses suffered by residents in their day to day activities and increases take up of health maintenance behaviour such as physical exercise. The recent focus on and specification of mechanisms (what goes on in a neighbourhood) are welcome. They remind us that social process remains to an important extent a spatial process. A formal model of neighbourhood social capital and health draws from Grossman health model and the increasingly popular social interaction model.

2 The Grossman model of health & its extensions to neighbourhood effects

An influential model of health production is due to Grossman (1972a); see also Grossman (1972b). Following the notation of Case and Deaton (2005), assume there is an instantaneous felicity function $\nu(c_t, H_t)$ where t is age, c_t is consumption, and H_t is the stock of health. Health is produced according to

$$H_{t+1} = \theta m_t + (1 - \delta_t) H_t \tag{1}$$

where m_t is the decisions and behaviours for maintenance of health (including medical care bought and health behaviours like regular physical exercise, m_t^+, and smoking, m_t^-), θ is the efficiency or conversion factor which is affected by education (and other socioeconomic status) and δ is the rate of health

deterioration at t. People maximise a life cycle welfare function

$$U = \sum_{0}^{T} (1+\rho)^t \nu(c_t, H_t) \tag{2}$$

where ρ expresses time preference, and T is the length of life. The welfare is optimized subject to full wealth constraint incorporating both wealth and time limits:

$$\sum_{0}^{T} \frac{c_t}{(1+r)^t} + \sum_{0}^{T} \frac{p_m m_t}{(1+r)^t} = W_0 + \sum_{0}^{T} \frac{y_t(H_t)}{(1+r)^t} \tag{3}$$

where r is the market rate of interest, p_m is the price of medical care and other health behaviours, W_0 is initial assets, and $y_t(H_t)$ is earning, a function of health.

Optimising the welfare function subject to the constraint as the health stock changes gives insights into, among others, the role of education and inequalities in health. These have been widely tested empirically by assuming functional forms for the elements of the theory (often of Cobb-Douglas form). Wagstaff (1986) provides some example assumptions which enable empirical estimation. On estimation, Van Doorslaer (1987) recommends a focus on health production function to avoid problems when estimating health demand function. Equations for health production function and for health maintenance suitable for estimation are:

$$H = H(M, W, X, \mu_h) \tag{4}$$

and

$$M = M(W, Y, \mu_m) \tag{5}$$

where W is wealth, X and Y include age, education and other exogeneous variables; and the μ's are residuals.

This is emphatically a recursive or triangular system as M, in turn, enters the health production function. This system is also known as multiprocess system. Recently, for example, Balia and Jones (2008)[1] estimated a similar recursive system of health maintenance behaviour, health outcomes and mortality. Their recursive structure is intuitively and formally in that order: health maintenance, health outcome, mortality.

I propose an extension broadening the formal model to include neighbourhood effects. This extension acts as a bridge between the economics of health and epidemiology and public health. In the Grossman model, demand for the maintenance of health, M, is narrowly and individually defined. However, if we construe maintenance to include general maintenance of health and avoidance of health risks then we are in a position to include neighbourhood effects. The benefits of this extension include increased scope of explanation and scope of policy intervention.

[1]The published version dropped citation to Grossman and introduced a typographic error compared to the working paper version.

2.1 Statistical mechanics of social interactions, social capital and health

Theoretical justification for including broader actions, specifically neighbours' actions, on resident's individual health is grounded in works on social interaction and its identification (Blume, 1993; Brock, 1993; Manski, 1993; Durlauf, 1997; Young, 1998; Becker and Murphy, 2000; Manski, 2000; Brock and Durlauf, 2001a,b; Glaeser and Scheinkman, 2001; Durlauf, 2002; Glaeser *et al.*, 2002; Glaeser and Scheinkman, 2003; Cutler and Glaeser, 2005; Durlauf and Fafchamps, 2005; Blume and Durlauf, 2005).

Blume, Brock and Durlauf in a series of papers cited above draw upon statistical mechanics to understand the process of social interactions and how individual choices within them give rise to interesting aggregate behaviors.[2] In our context, social interactions facilitate the various forms of social capital which give rise to aggregate or widespread health behaviors such as jogging or smoking in the neighborhood.

I follow closely Durlauf (1997) and Brock and Durlauf (2001a) which consider a binary choice setting.[3] This setting allows all parameters to be given their structural interpretation and facilitates econometric identifica-

[2]The neighbouring field of spatial statistics which is interested in *spatial* interactions also draws upon the same statistical mechanics literature, see Ripley (1990).

[3]Their model parallels the probability structure of the so-called Curie-Weiss model in statistical mechanics (Brock and Durlauf, 2001a, p. 240). They refer to Ellis (1985, chapter 4) though Parisi (1988, p. 24ff §3.2) and Baxter (1982, p. 39ff §3.1) give more accessible accounts of Ising model with mean field which result in similar aggregate behaviour of magnetization m^*.

tion. Other works (Brock and Durlauf, 2001b; Durlauf, 2002) discuss identification in linear-in-means setting as discussed below. Each individual is set in a population N where social interactions are present. Each individual resident chooses a binary action m_i with support $\{-1, 1\}$. This support, instead of the usual $\{0, 1\}$, is common in social interactions model and shows its provenance in statistical mechanics. There the support is typicaly 'spin up' and 'spin down' and the aggregate behavior of 'population' of interest is typically macroscopic magnetization.

Individual utility $V(m_i)$ is assumed to consist of three terms: private utility associated with a choice, $u(m_i)$; social utility associated with the choice, $S(.,.)$; and a random utility term which is independently and identically distributed, $\epsilon(m_i)$; in the following equation,

$$V(m_i) = u(m_i) + S(m_i, \mu_i^e(m_{\backslash i})) + \epsilon(m_i). \tag{6}$$

The term $\mu_i^e(m_{\backslash i})$ denotes the conditional probability resident i puts on the choice of others at the time of making its own decision. In case of indiscriminate or total strategic complementarity, this social utility depends solely on $\overline{w}_i^e = (N-1)^{-1} \sum_{i \neq j} w_{i,j}^e$, where $w_{i,j}^e$ denotes the subjective expected value from the perspective of resident i of resident j choice.

Brock and Durlauf assume parametric forms for the social utility term and the probability density of the random utility term.[4] They consider forms

[4]Physicists, instead, start with the working assumption that the coordinates and momenta in the equation of motion, at equlibria, follow the canonical distribution given by

of social utility which exhibit indiscriminate strategic complementarity, as above, and are constant. The social utility then obeys $\frac{\partial S(m_i,\overline{w}_i^e)}{\partial m_i \partial \overline{w}_i^e} = J > 0$. These forms allow capture of the degree of dependence across residents' choices in a single parameter. With the constant degree of dependence, two forms of social utility suggest themselves. First, $S(m_i, \overline{w}_i^e) = Jm_i\overline{w}_i^e$ which exhibits proportional spillovers (strength of dependence). Second, $S(m_i, \overline{w}_i^e) = -\frac{J}{2}(m_i - \overline{w}_i^e)^2$ which exhibits conforming or restraining norms. The latter penalises deviations from the mean more strongly than the former. Additionally, the two forms differ in levels.

With ϵ's assumed to be independent and extreme-value distributed, the differences in the errors become logistically distributed. This widely used assumption in discrete choice literature, see e.g. Maddala (1983), allows a direct link between the theoretical model and its econometric estimation.

To derive equilibrium condition, assume that decisions are made in non-cooperative fashion, that is, each resident makes a choice without strategic communication or coordination. It follows from the extreme-value distribution assumption that

$$\text{Prob}(m_i) = \frac{\exp(\beta(u(m_i) + Jm_i\overline{w}_i^e))}{\sum_{n_i \in \{-1,1\}} \exp(\beta(u(n_i) + Jn_i\overline{w}_i^e))}. \tag{7}$$

The parameter β gives the extent to which the deterministic components of utility determine actual choice. Because of independence, the joint prob-

the so-called Boltzmann formula. See Parisi (1988, eq. (1.5) p.2) or Baxter (1982, eq. (1.4.1) p.8).

ability over all choices is

$$\text{Prob}(\mathbf{m}) = \frac{\exp(\beta(\sum_1^N (u(m_i) + Jm_i\overline{w}_i^e)))}{\sum_{n_1\in\{-1,1\}}\cdots\sum_{n_N\in\{-1,1\}}\exp(\beta(\sum_1^N (u(n_i) + Jn_i\overline{w}_i^e)))}. \quad (8)$$

In the absence of social interaction effect, $J = 0$, the probability above is proportional to logistic density; in its presence, $J \neq 0$, it captures interaction influence on behaviors in the neighbourhood.

They then linearise the private utility $u(m_i) = hm_i + k$ with a further inspiration from statistical mechanics.[5] With this linearization, and using the definition of hyperbolic functions, the expectation becomes

$$\text{E}(m_i) = \tanh(\beta(h + J(N-1)^{-1}\sum_{i\neq j} m_{i,j}^e)). \quad (9)$$

Furthermore, self-consistent and symmetric beliefs of residents (no residents are privileged) give $\text{E}(m_i) = \text{E}(m_j)\forall i, j$. Together with the last equation, these guarantee there exists at least one expected choice level m^* (Brock and Durlauf, 2001a, Proposition 1):

$$m^* = \tanh(\beta(h + Jm^*)) \quad (10)$$

Existence of equilibrium is one thing; its identification is another. Identification has always been a fraught issue in social interaction models. As

[5] Again see (Parisi, 1988, p. 2ff) on h the magnetic field and k the Boltzmann coefficient.

examples, Manski (1995) and Durlauf (2002) have done a lot of works on deriving conditions for identification in linear and non-linear models of social interaction. Manski (2000, p. 129) lists possibilities of identification including time lage and spatial lag of individual behaviors, non-linear model such as Brock and Durlauf's above or other non-linearity e.g. median neighbourhood behaviour, and instrumental variable which affects the outcomes of a subset of the neighbours. The last one is most relevant here. Durlauf (2002, Proposition 3 p. F468) demonstrates that two or more instruments are needed to estimate the effect of neighborhood social capital on an individual outcome; see also Brock and Durlauf (2001b) on linear-in-means model identification.

In sum, social interaction models lay the foundation for understanding the effects of social interaction in neighbourhood on individual resident behavior. With suitable instruments, the effect of social capital facilitated by social interaction on individual health can be estimated. In fact, the formal model shows that ignoring social interaction may lead to under-specified model. Leaving out social interaction effectively assumes it to be negligible, $J = 0$, and admits no possibility of it being beneficial or harmful, $J \neq 0$.

Somewhat more prosaically, obesity can be used as an illustration of social interaction. We are told that food portions in America have increased in the last three decades (Nielsen and Popkin, 2003). Finishing the increasingly hearty plate clean, while dining out with friends, is an instance of social interaction influencing health behaviour in a negative way, m_t^-. What one orders to begin with ("Just a salad for me." Or "The full monty, please") and what

one finishes are not unrelated to what everyone else around the table order or finish. This scene extends, with attenuation, over to the neighbourhood and over time. For instance, Christakis and Fowler (2007) suggest that in Framingham, greater Boston, network of friends act as conduit of acceptable norm of body weight. Operating over 30 years, interactions in these networks of friends led to increase in obesity through these social interactions. The authors were careful to account for individual socio-demographic factors and other place-based factors. Across the Atlantic, Tampubolon *et al.* (2009) find, in a national sample in Wales, that friendly neighbours and neighbourhoods also lead to increase in obesity. They also separate out the effect of individual sociodemographic and geographic factors in a multilevel multiprocess model which simultaneously explain consumption, physical exercise and obesity. Both these empirical studies go some way into revising the notion that social capital is always or primarily associated with positive benefits as read by Durlauf and Fafchamps (2005).[6]

Glaeser and Scheinkman (2003, p. 352) show that, for estimable discrete equilibria, it is sufficient that the second derivative of utility with respect to

[6]In this connection, none other than Brock and Durlauf (2001b, p. 166ff) would welcome such empirical studies. "... this hardly means that these literatures [under-theorised empirical studies in the sense below] are incapable of providing useful insights. In this respect, we find arguments to the effect that because an empirical relationship has been established without justification for auxilary assumptions such as linearity, exogeneity of certain variables, etc., one can ignore it, to be far overstated. In our view, empirical work establishes greater or lesser degrees of plausibility for different claims about the world and therefore the value of any study should not be reduced to a dichotomy between full acceptance or total rejection of its conclusions. Hence the determination of the plausibility of any exclusion restriction is a matter of degree and dependent on its specific context."

one's own action is greater than partial cross-derivative between one's own action and the neighbours' group action. Or $\left|\frac{\partial^2 v_i}{\partial m_i^2} / \frac{\partial^2 v_i}{\partial m_i \partial S_i}\right| > 1$. This they call moderate social influence condition. It means the effect of one's action on one-self must be greater than the induced effect through social interaction on one's neighbours.

Again, using obesity as an illustration: jogging, a health maintenance behavior m_t^+, by an individual should improve the individual's body mass composition. *Ceteris paribus*, this improvement should be greater than induced improvement in the body mass composition of the neighbours. Some neighbours were inspired to take up jogging while others were not. Or, take smoking, a known health risk. Smoking by an individual harms the individual's health. This deleterious effect should be more severe for that individual than induced harm in the health of the neighbours through either passive smoking or through social interaction or social norm effect. Excessive drinking and social drinking work similarly. In these cases, the moderate social influence condition is satisfied. One case where the condition is perhaps not satisfied is unprotected sex. Fortunately, I am not applying this extended theory to this case.

Because social interaction can produce discrete multiple equilibria in health behaviours, it is not surprising to observe different neighbourhoods in greater Boston (for instance, Framingham versus Backbay) to possess different obesity rates. The discreteness, hence the possibility of estimating them, is guaranteed by the moderate social influence condition.

Notably, this moderate social influence condition is consistent with the basic tenet of epidemiology or public health research (Rose, 1992) in the form of 'population strategy'. In the words of Rose (1992, p. 135) "A 10 per cent lowering of the population's levels of blood cholesterol can be expected to reduce coronary heart disease by 20-30 per cent, and such a reduction of a condition that now kills one-quarter of the population would be a benefit indeed. A reduction of one-third in the nation's salt intake, ... might also reduce by up to one-half the number of people requiring drug treatment for hypertension." It is well known that neighbourhood effect of health behaviour is usually smaller, often an order of magnitude smaller, than the individual effect or coefficient (in individual regression or in multilevel regression). The threshold for effect magnitude in a public health setting can be lower than that in a clinical setting. An intervention bringing two percent decrease in the average population body mass index is already considered important though an order of magnitude effect is perhaps needed for a clinically obese individual. This lower threshold for population or higher sensitivity is accepted because one bears in mind that the ultimate effect is for the whole population and not confined to a single individual.

In parallel to theoretically recognising the importance of social interaction, it is practicaly acknowledged that built (physical) and social features of neighbourhood can induce benefits as well as pose risks of health (Srinivasan *et al.*, 2003). In sum, the recursive system (equations 4 & 5) incorporating insights from social interaction (equation 10) is modified by including

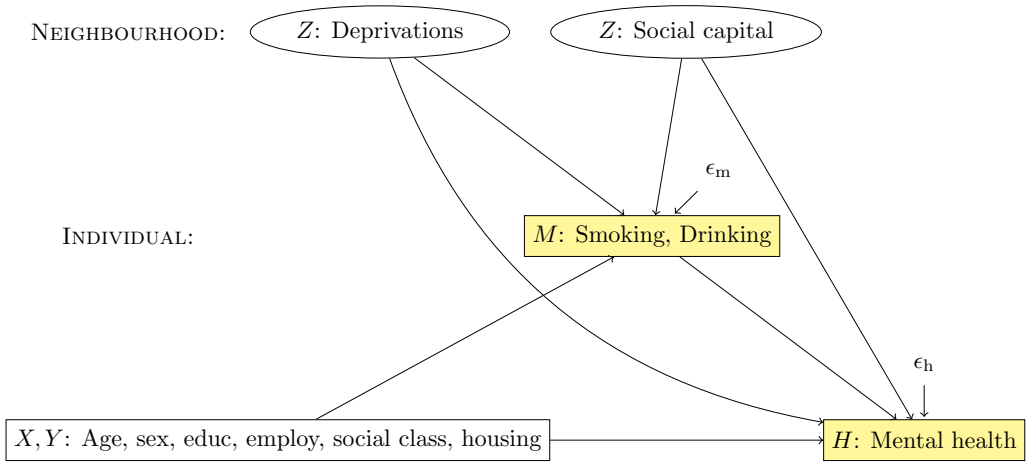

Figure 1: Health maintenance (M) and production (H) in their individual and neighbourhood contexts.

neighbourhood effects. These include effects such as neighbourhood social capital and neighbourhood deprivation (to capture lack of leisure space for social interactions), Z, in the health production function.This is estimated as a reduced form using instrumental variable estimation.

The extended model can also be presented as in Figure 1 where it is depicted that processes determining health are not circumscribed entirely within the individual but are also affected by neighbourhood social capital and deprivation. By implication, although this extended model is conceived to explain mental health, its application is broad and encompasses other health outcomes such as obesity. The demonstration below shows promising ways of examining how individual and neighbourhood factors bring about healthy outcomes.

2.2 Instruments for estimation of neighbourhood effect

The moderate social influence condition is not a constructive condition though; it does not show how to estimate the effect of individual and neighbourhood factors. In the absence of randomised experiment moving residents from one neighbourhood to another, instrumental variable estimation is deemed second best. Instruments, v, must satisfy both exclusion restriction, $\mathrm{E}(v, \epsilon) = 0$, and relevance condition, $\mathrm{E}(v, Z) \gg 0$. It is well known that the exclusion restriction is essentially untestable due to unobserved ϵ hence strong theory like the extended Grossman model is needed; whereas the strength of the correlation is routinely judged using a rule of thumb of F statistics greater than ten Angrist and Pischke (2009); Cameron and Trivedi (2005).

Neither the original Grossman model nor the proposed extension has any role for neighbourhood ethnic diversity, hence $\mathrm{E}(\text{diversity}, \epsilon) = 0$. Ethnic diversity as an instrument thus satisfies the exclusion restriction. Furthermore, Putnam (2007) demonstrates that ethnic diversity can erode social capital. This motivates the instrument's relevance. Such test of relevance will be provided below. Lastly, the length of residence proxies attachment to the neighbourhood. Hence the felt erosion intensifies with length of residence. Phrased differently, transient resident may not be affected one way or another by changes in neighbourhood ethnic diversity or social capital; long-time residents are. In summary, neighbourhood ethnic diversity and average

length of residence are the instruments.

3 Data

The Welsh Assembly Government generously provided two independent surveys: *Welsh Health Survey 2007* (WHS) and *the Living in Wales 2007* (LiW) survey. The WHS selected a random sample of postcode sectors from the Post Office's Postcode Address File. The sample was stratified by the 22 unitary authorities where 30 addresses were selected in each of them. Health measurements were requested for adults and all selected children aged between 2 and 15 years old by health professionals. Written consent, in English or Welsh, to these measurements was obtained in advance. Interviewers, who speak English or Welsh, carried out the interviews and measurements according to a standardised written protocol. Adults response to the survey is 82.1 percent. More details are available in the technical report (Fuller and Heeks, 2008).

The neighbourhood here is defined as the local super output area, a geographical unit purposefully designed for social research and comprises an area of about 500 households (Policy Action Team 18, 2000; The Office for National Statistics and the Office of the Deputy Prime Minister, 2004, 2005). Such definition of an area compares favourably with other studies using wider or more heterogeneous definition of neighbourhood.

I select neighbourhood and individual variables to conform to the ex-

tended Grossman model. The neighbourhood deprivation measure is the official index of multiple deprivations for Wales 2005 which captures lack of access to various facilities. Neighbourhood social capital measures capture the 'bonding' and 'network' social capital available in the neighbourhood. The Living in Wales survey collected information on trust, sense of community and friendliness of neighbours. These information are averaged for each neighbourhood to provide the neighbourhood social capital measures. The social capital questions follow.

- Would you say that you trust 'most of the people in the neighbourhood', 'many', 'a few', or 'do not trust people in the neighbourhood'.

- What do you like most about living in this neighbourhood? What else? Options include 'I feel like I belong to this neighbourhood', 'The friendships and associations I have with other people in my neighbourhood mean a lot to me'.

The instrument of ethnic diversity is constructed using the Herfindahl index scaled to range between 0 and 1 as is common in the literature on ethnic diversity and social capital (Putnam, 2007; Letki, 2008). The average length of residency is constructed from the Living in Wales survey accordingly.

Linking the Welsh Health Survey and Living in Wales Survey The WHS is augmented with neighbourhood social capital information from the LiW using the unique local super output area (neighbourhood) assigned to

each respondent. A total of 1152 neighbourhoods were matched to 13917 respondents; there reside around 19 residents per neighbourhood with a minimum of 1 and a maximum of 56. Some respondents did not provide sociodemographic information required by the extended model, hence they are removed. The final file comprise of 13557 respondents with information on health, sex, social class, education, and tenure, plus neighbourhood information such as social capital and deprivation.

4 Results

Basic description about the sample, given in Table 1, shows that it is gender balanced though tend to be older (range 16 to 75). Trust is quite abundant since residents tend to trust many around them. Given the choice of completely agree, agree, indifferent, and completely disagree, residents tend to agree with the opinion that local friendship mean a lot and with the feeling that they belong to the neighbourhood. Neighbourhood deprivations tend to be on the low 20s (range: 0 to 100).

The results of instrumental variable estimator are given in Table 2. I elaborate on the neighbourhood deprivation and social capital effects first. Over and above individual determinants and behaviours, neighbourhood effects matter sizably and significant at 10 percent. Neighbourhood deprivation harms physical health quality of life. However, two forms of neighbourhood social capital more than compensate for this deleterious effect. Living in a

Table 1: Basic description of the sample

Variable	Mean/mode*
SF36 physical summary	48.0
Women	54%
Age (5 yr group)*	55-59,75+
Employed	47%
Unemployed	1.4%
Professional	35%
Intermediate	19%
Tenure own	78%
Tenure private	7.4%
Degree educated	15%
Neighbourhood deprivation: IMD 2005	20.88
Trust people in the neighbourhood	2.2 (Many)
Local friendships mean a lot	1.0 (Agree)
I feel like I belong to this neighbourhood	1.1 (Agree)

trusting neighbourhood (compared to living in less trusting neighbourhood) independent of whether the resident is trusting of other people, increases the resident's mental health by 1.4 point. SF 36 is constructed to have a mean of 50 and a standard deviation of ten. Next in gainful benefit is sense of belonging where it improves mental health by 1.1 point. The generous level of significance is perhaps excused by the overall significance of two forms of social capital as well as the inefficiency of the estimator. Furthermore, given the predominantly null findings in the literatureDuncan *et al.* (1993); Sloggett and Joshi (1998); Mohan *et al.* (2005); Propper *et al.* (2005); Stafford *et al.* (2008), the overall pattern of significant effects of different forms of social capital is encouraging.

Tests of instruments' strength and relevance (F, Hansen J and its p value)

Table 2: Neighbourhood social capital and individual mental health (SF36)

	β	p	β	p	β	p
INDIVIDUAL						
Female	-1.959	0.000	-1.977	0.000	-1.957	0.000
Age	-0.578	0.000	-0.535	0.000	-0.574	0.000
Age^2	0.054	0.000	0.051	0.000	0.054	0.000
Class: professional	1.002	0.000	1.171	0.000	1.046	0.000
Class: intermediate	1.004	0.001	1.170	0.000	1.083	0.000
Tenure: owner	3.098	0.000	3.174	0.000	3.035	0.000
Tenure: private tenant	1.120	0.056	1.416	0.024	1.103	0.057
Degree educated	0.091	0.715	0.062	0.814	0.086	0.729
Last year subj. health	-3.574	0.000	-3.552	0.000	-3.556	0.000
Alcohol consumption	0.530	0.000	0.529	0.000	0.537	0.000
Smoking	1.008	0.000	0.990	0.000	1.024	0.000
NEIGHBOURHOOD						
Deprivation	-0.021	0.277	-0.040	0.001	-0.040	0.000
Trust	1.415	0.098				
Friendly place			6.660	0.105		
Belong to nhood					1.118	0.065
Constant	53.807	0.000	54.066	0.000	55.840	0.000
J statistics	1.002	0.317	0.001	0.979	0.573	0.449
F statistics	12.491		3.217		31.636	

confirm the usefulness of the instruments in identifying the effects of social capital. In this context, one should not read too much into the substance of the instruments' relationships with social capital (i.e. as captured in the implicit 'first stage' regression). There is nothing inevitable nor immutable about the relationship between ethnic diversity and residence length on the one hand and social capital on the other. For contrasting views about this, see Putnam (2007) and Letki (2008).

Individual effects Men claim to be healthier; age does take a toll (perhaps a curvilinear effect should be allowed for). Health inequality in occupational status is apparent here: the manual workers (compared to the professional and intermediate workers) tend to be less healthier. Other measure of socioeconomic status, education appears not to stratify mental health in the population.

Last year subjective health condition is the strongest predictor of mental health. A measure of wealth, housing tenure, has the second strongest and significant influence on health. Residents who own their houses or flats have their health quality of life improved by a third of the standard deviation of SF36. This is unsurprising given wealth is well known to improve health since it allows access to healthy foods and active leisure among others.

Respondents who smoke and drink report better mental health. There is a sizeable literature on these behaviours; it discusses these behaviours as somehow mentally 'comforting'. For instance, Lasser *et al.* (2000) elaborates on the relationship between smoking and mental health. Notably, the sizes of the effects are comparable to those of social capital. In other words, similar improvement in mental health can be gained by smoking/drinking (a health risk) of by living in a trusting neighbourhood.

5 Discussion and conclusion

Compared to recent studies on neighbourhood social capital and health in developed countries such as Sweden, New Zealand and England, this study presents a visible contrast (Blakely *et al.*, 2006; Islam *et al.*, 2006; Duncan *et al.*, 1993; Sloggett and Joshi, 1998; Mohan *et al.*, 2005; Propper *et al.*, 2005; Stafford *et al.*, 2008). Neighbourhood social capital is generally beneficial to individual mental health.

An extended theoretical model allows causal effects of neighbourhood social capital to be estimated. It achieves this by motivating strong instruments which help to recover the effect of neighbourhood social capital on individual health related quality of life. Various aspects of neighbourhood social capital, including social cohesion aspects (trust, sense of belonging) and network aspects (friendly neighbours), are effective in improving individual health. Any of these social capital is shown to more than compensate the deleterious effect of overall neighbourhood deprivation. These causal effects help to point out entries for public health interventions in the neighbourhood as well as the individual. For instance, interventions to make neighbourhood spaces more friendly for interaction can prove to be beneficial to health quality of life.

Given that the effect of neighbourhood social capital on individual health is elusive in other industrial countries, why is it different with Wales? It might be tempting to explain this result in the commonly accepted argu-

ment of egalitarian society (Islam *et al.*, 2006). In highly unequal society, neighbourhood social capital tends to be effective to fill in the vacuum of needed health services that are not provided by the state or other organisations. Yet this is not the case with Wales since the UK National Health Service provides such services.

The extended Grossman health production function combined with independent neighbourhood social capital measures may have uncovered the elusive effect of neighbourhood social capital. Previous studies may not have benefited from recent methodological development nor have the fortune of access to independent data. Mohan *et al.* (2005) for instance desired for the latter to address their null finding on the effect of social capital. The extended Grossman model is applicable in settings other than health quality of life and it is now easier to trace the mechanisms how neighbourhood social capital improves individual health.

This study is far from a definite statement about how social interactions, social capital, and health are inter-related. It rather seeks to provide a useful extension to a well known model and demonstrate its efficacies in empirical setting. Notwithstanding its many shortcomings, including certain challenging problems of dynamics and neighbourhood selection,[7] it is my belief that further progress can be made after demonstrating fruitful avenues of exploration. Given these challenges, and the undeniable importance of

[7]Following the theoretical papers cited above including Brock and Durlauf (2001a, p. 254), I set aside the issue of neighbourhood selection for future work. This is likely to need longitudinal data on both neighborhood and residents to do justice to its complexity.

social interactions, social capital, and health,[8] this paper should be taken as an initial foray. Its conclusions must be revised or confirmed with further evidence (at different time, place, and outcome).

The last words should probably go to Geoffrey Rose. Despite the difficulties, anticipated by prominent economists[9], facing researchers setting out to examine the effects of social interactions and social capital on individual health, one should not be disheartened. Ultimately, as Rose (1992, p. 161) insisted, "The primary determinants of disease are mainly economic and social, and therefore its remedies must also be economic and social. Medicine and politics cannot and should not be kept apart."

References

Angrist, J. D. and Pischke, J.-S. (2009). *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton, New Jersey: Princeton University Press.

[8]Lane (2000) goes so far as recommending companionship or social interaction as a virtue given the apparent paradox of stagnating happiness on the face of increasing affluence in Western societies.

[9]Some samples follow. Dasgupta (2000, p. 4) notes, 'the idea of social capital sits awkwardly in contemporary economic thinking. Even though it has a powerful, intuitive appeal, it has proven hard to track as an economic good ... it is fiendishly difficult to measure ... because we don't quite know what we should be measuring.' Arrow (2000, p. 4) warns, 'I would urge abandonment of the metaphor of capital and the term social capital.' And Solow (2000, pp 6,9) chooses 'to be critical of the concept of social capital and the way it is used ... [however] there is something to look for that is at least capable of being found.'

Arrow, K. J. (2000). 'Observations on social capital', in Dasgupta and Serageldin (2000), pp. 3–5.

Balia, S. and Jones, A. M. (2008). 'Mortality, lifestyle and socio-economic status', *Journal of Health Economics*, vol. 27(1), pp. 1–26.

Baxter, R. J. (1982). *Exactly Solved Models in Statistical Mechanics*, London: Academic Press.

Becker, G. S. and Murphy, K. M. (2000). *Social Economics: Market Behavior in a Social Environment*, Cambridge, MA: Harvard University Press.

Berkman, L. F. and Kawachi, I. (eds.) (2000). *Social Epidemiology*, Oxford, UK: Oxford University Press.

Blakely, T., Atkinson, J., Ivory, V., Collings, S., Wilton, J., and Howden-Chapman, P. (2006). 'No association of neighbourhood volunteerism with mortality in New Zealand: a national multilevel cohort study', *International Journal of Epidemiology*, vol. 35, pp. 981–989.

Blume, L. E. (1993). 'The statistical mechanics of strategic interaction', *Games and Economic Behavior*, vol. 5(3), pp. 387–424.

Blume, L. E. and Durlauf, S. N. (2005). 'Identifying social interactions: A review', mimeo, Cornell University.

Brock, W. A. (1993). 'Pathways to randomness in the economy: Emergent

nonlinearity and chaos in economics and finance', *Estudios Economicos*, vol. 8(1), pp. 3–55.

Brock, W. A. and Durlauf, S. N. (2001a). 'Discrete choice with social interactions', *The Review of Economic Studies*, vol. 68(2), pp. 235–260.

Brock, W. A. and Durlauf, S. N. (2001b). 'Interactions-based models', in J. J. Heckman and E. Leamer (eds.) *Handbook of Econometrics*, vol. 5, chap. 54, Amsterdam: North Holland.

Cameron, A. C. and Trivedi, P. K. (2005). *Microeconometrics: Methods and Applications*, Cambridge, England: Cambridge University Press.

Case, A. and Deaton, A. (2005). 'Broken down by work and sex: How our health declines', in D. A. Wise (ed.) *Analyses in the Economics of Aging*, Chicago: University of Chicago Press, pp. 185–212.

Christakis, N. A. and Fowler, J. H. (2007). 'The spread of obesity in a large social network over 32 years', *The New England Journal of Medicine*, vol. 357, pp. 370–379.

Cutler, D. and Glaeser, E. L. (2005). 'What explains differences in smoking, drinking and other health-related behaviors?', Discussion Paper 2060, Harvard Institute of Economic Research.

Dasgupta, P. (2000). 'Economic progress and the idea of social capital', in Dasgupta and Serageldin (2000), pp. 325–424.

Dasgupta, P. and Serageldin, I. (eds.) (2000). *Social Capital: A Multifaceted Perspective*, Washington, DC: World Bank.

Duncan, C., Jones, K., and Moon, G. (1993). 'Do places matter? A multilevel analysis of regional variations in health-related behaviour in Britain', *Social Science & Medicine*, vol. 37(6), pp. 725–733.

Durlauf, S. N. (1997). 'Statistical mechanics approaches to socioeconomic behavior', in W. B. Arthur, S. N. Durlauf, and D. A. Lane (eds.) *The Economy As An Evolving Complex System II*, A proceedings volume in the Santa Fe studies in the sciences of complexity, Addison Wesley, pp. 81–104.

Durlauf, S. N. (2002). 'On the empirics of social capital', *Economic Journal*, vol. 112(483), pp. F459–F479.

Durlauf, S. N. and Fafchamps, M. (2005). 'Social capital', in P. Aghion and S. N. Durlauf (eds.) *Handbook of Economic Growth*, vol. 1, chap. 26, Amsterdam: North Holland.

Ellis, R. S. (1985). *Entropy, Large Deviations, and Statistical Mechanics*, Berlin: Springer Verlag.

Farquhar, S. A., Michael, Y. L., and Wiggins, N. (2005). 'Building on leadership and social capital to create change in 2 urban communities', *American Journal of Public Health*, vol. 95(4), pp. 596–601.

Fuller, E. and Heeks, F. (2008). 'Welsh Health Survey 2007 Technical Report: Prepared for the Welsh Assembly Government', Tech. rep., National Centre for Social Research.

Glaeser, E. L., Laibson, D., and Sacerdote, B. (2002). 'An economic approach to social capital', *Economic Journal*, vol. 112, pp. F437–F458.

Glaeser, E. L. and Scheinkman, J. A. (2001). 'Measuring social interactions', in S. N. Durlauf and H. P. Young (eds.) *Social Dynamics*, Cambridge, MA: MIT Press, pp. 83–131.

Glaeser, E. L. and Scheinkman, J. A. (2003). 'Nonmarket interactions', in M. Dewatripont, L. P. Hansen, and S. J. Turnovsky (eds.) *Advances in Economics and Econometrics: Theory and Applications, Eighth World Congress*, vol. I, Cambridge: Cambridge University Press, pp. 339–369.

Grossman, M. (1972a). *The Demand for Health: a Theoretical and Empirical Investigation*, National Bureau of Economic Research, occasional Paper 119.

Grossman, M. (1972b). 'On the concept of health capital and the demand for health on the concept of health capital and the demand for health', *The Journal of Political Economy*, vol. 80(2), pp. 223–255.

Islam, M. K., Merlo, J., Kawachi, I., Lindström, M., Burström, K., and Gerdtham, U. G. (2006). 'Does it really matter where you live? A panel

data multilevel analysis of Swedish municipality-level social capital on individual health-related quality of life', *Health Economics, Policy and Law*, pp. 209–235.

Kawachi, I. and Berkman, L. F. (eds.) (2003). *Neighbourhoods and Health*, Oxford, UK: Oxford University Press.

Kawachi, I., Bruce P Kennedy, K. L., and Prothrow-Stith, D. (1997). 'Social capital, income inequality, and mortality', *American Journal of Public Health*, vol. 87(9), pp. 1491–1498.

Kawachi, I., Kennedy, B. P., and Glass, R. (1999). 'Social capital and self-rated health: A contextual analysis', *American Journal of Public Health*, vol. 89(8), pp. 1187–1193.

Lane, R. E. (2000). *The Loss of Happiness in Market Democracies*, New Haven: Yale University Press.

Lasser, K., Boyd, J. W., Woolhandler, S., Himmelstein, D. U., McCormick, D., and Bor, D. H. (2000). 'Smoking and mental illness: A population-based prevalence study', *Journal of the American Medical Association*, vol. 284(20), pp. 2606–2610.

Letki, N. (2008). 'Does diversity erode social cohesion? Social capital and race in British neigbourhoods', *Political Studies*, vol. 56(1), pp. 99–126.

Maddala, G. S. (1983). *Limited-dependent and qualitative variables in econometrics*, Econometric Society Monographs, Cambridge University Press.

Manski, C. F. (1993). 'Identification of endogenous social effects: The reflection problem', *Review of Economic Studies*, vol. 60, pp. 531–542.

Manski, C. F. (1995). *Identification Problems in the Social Sciences*, Cambridge, MA: Harvard University Press.

Manski, C. F. (2000). 'Economic analysis of social interactions', *Journal of Economic Perspectives*, vol. 14(3), pp. 115–136.

Mohan, J., Twigg, L., Barnard, S., and Jones, K. (2005). 'Social capital, geography and health: a small-area analysis for England', *Social Science & Medicine*, vol. 60(6), pp. 1267–1283.

Nielsen, S. J. and Popkin, B. M. (2003). 'Patterns and trends in food portion sizes, 1977-1998', *Journal of the American Medical Association*, vol. 289(4), pp. 450–453.

Parisi, G. (1988). *Statistical Field Theory*, Redwood City, CA: Addison Wesley.

Perry, M., Williams, R. L., Wallerstein, N., and Waitzkin, H. (2008). 'Social capital and health care experiences among low-income individuals', *American Journal of Public Health*, vol. 98(2), pp. 330–336.

Policy Action Team 18 (2000). 'Report of Policy Action Team 18: Better Information', URL `www.cabinetoffice.gov.uk/media/cabinetoffice/social_exclusion_task_force/assets/publications_1997_to_2006/pat_report_18.pdf`, accessed 19 May 2009.

Propper, C., Jones, K., Bolster, A., Burgess, S., Johnston, R., and Sarker, R. (2005). 'Local neighbourhood and mental health: Evidence from the UK', *Social Science & Medicine*, vol. 61(10), pp. 2065–2083.

Putnam, R. D. (1993). *Making Democracy Work: Civic Traditions in Modern Italy*, Princeton, with Robert Leonardi and Raffaella Y. Nanetti.

Putnam, R. D. (2007). '*E Pluribus Unum*: Diversity and community in the twenty-first century. the 2006 Johan Skytte Prize lecture', *Scandinavian Political Studies*, vol. 30(2), pp. 137–174.

Ripley, B. D. (1990). 'Gibbsian interaction models', in D. A. Griffith (ed.) *Spatial Statistics: Past, Present, and Future*, Ann Arbor, MI: Institute of Mathematical Geography, pp. 3–53.

Rose, G. (1992). *Rose's Strategy of Preventive Medicine*, Oxford University Press.

Sloggett, A. and Joshi, H. (1998). 'Deprivation indicators as predictors of life events 1981 - 1992 based on the UK ONS longitudinal study', *Journal of Epidemiology and Community Health*, vol. 52(4), pp. 228–233.

Solow, R. M. (2000). 'Notes on social capital and economic performance', in Dasgupta and Serageldin (2000), pp. 6–9.

Srinivasan, S., O'Fallon, L. R., and Dearry, A. (2003). 'Creating healthy communities, healthy homes, healthy people: Initiating a research agenda

on the built environment and public health', *American Journal of Public Health*, vol. 93(9), pp. 1446–1450.

Stafford, M., De Silva, M. J., Stansfeld, S., and Marmot, M. (2008). 'Neighbourhood social capital and common mental disorder: Testing the link in a general population sample', *Health & Place*, vol. 14(3), pp. 394–405.

Subramanian, S. V., Kim, D., and Kawachi, I. (2005). 'Covariation in the socioeconomic determinants of self rated health and happiness: a multivariate multilevel analysis of individuals and communities in the USA', *Journal of Epidemiology and Community Health*, vol. 59, pp. 664–669.

Tampubolon, G., Kawachi, I., and Subramanian, S. (2009). 'Neighbourhood social capital and individual obesity: evidence from a national sample', In preparation for Social Science & Medicine.

The Office for National Statistics and the Office of the Deputy Prime Minister (2004). 'Neighbourhood Statistics: Report to Ministers 2001-2003', URL `neighborhood.statistics.gov.uk/HTMLDocs/images/NeSS-Report_tcm97-51085.pdf`, accessed 19 May 2009.

The Office for National Statistics and the Office of the Deputy Prime Minister (2005). 'Neigbourhood statistics: Geography policy', URL `www.neighbourhood.statistics.gov.uk/HTMLDocs/images/GeographyPolicy_tcm97-51009.pdf`, accessed 19 May 2009.

Van Doorslaer, E. K. (1987). *Health, knowledge and the demand for medical care: An econometric analysis*, Ph.D. thesis, Rijkuniversiteit Limburg te Maastricht.

Viswanath, K., Steele, W. R., and Finnegan, Jr, J. R. (2006). 'Social capital and health: Civic engagement, community size, and recall of health messages', *American Journal of Public Health*, vol. 96(8), pp. 1456–1461.

Wagstaff, A. (1986). 'The demand for health: some new empirical evidence', *Journal of Health Economics*, vol. 5(3), pp. 195–233.

Ware, J. E. (2004). 'SF-36 health survey update', in M. E. Maruish (ed.) *The Use of Psychological Testing for Treatment Planning and Outcomes Assessment*, Lawrence Erlbaum Associates, pp. 693–718.

Wilkin, D., Hallam, L., and Doggett, M.-A. (1992). *Measures of Need and Outcome for Primary Health Care*, Oxford: Oxford University Press.

Woolcock, M. (1998). 'Social capital and economic development: Toward a theoretical synthesis and policy framework', *Theory and Society*, vol. 27(2), pp. 151–208.

Young, H. P. (1998). *Individual Strategy and Social Structure: An Evolutionary Theory of Institutions*, Princeton, NJ: Princeton University Press.