Multilevel anchoring vignettes for comparative study of health inequalities in 48 countries of the WHO†

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Summary. Three elements of cross-country comparative study can help in the study of complex and heterogeneous concept such as health status inequality across the world. The elements include: substantive theory, anchoring vignettes and bespoke survey. I propose an extended health capital theory which includes the effect of community or country social capital in the improvement of individual health. I also extend the anchoring vignettes with random intercepts since cross-country comparative study increasingly investigate large numbers of countries and their residents. The data source for the application is the World Health Survey, a specially tailored survey with anchoring vignettes of various dimensions of individual health status. This study applies random effect anchoring vignettes modelling to test the claim that country level social capital improves individual health status, in particular it reduces the level of mobility-problems dimension of health. The results show that country level social capital as measured using average trust in other people reduces the number of individual mobility problems, after controlling for the country's level of development, individual age and gender.

1. Introduction and aims

Health and life quality are important goals in life. But measuring complex concepts such as health status, let alone comparing them across nations, is never easy despite the variety of instruments. Mortality measure is the ultimate exception.

Recently for comparative cross-national studies, anchoring vignettes modelling has been proposed for measuring a wide variety of concepts that presents two important challenges: inherent complexity and individual/cultural heterogeneity. Political efficacy and health status are two prominent concepts with these challenges. Health status is a real but complex individual summary concept. Individuals often answer questions about health status using their own unobserved individual scale. The first person's poor health may not be comparable to the next one's. Vignettes modelling is designed to solve these problems of inherent complexity and individual heterogeneity [Kapteyn et al., 2007, King et al., 2004, Salomon et al., 2004].

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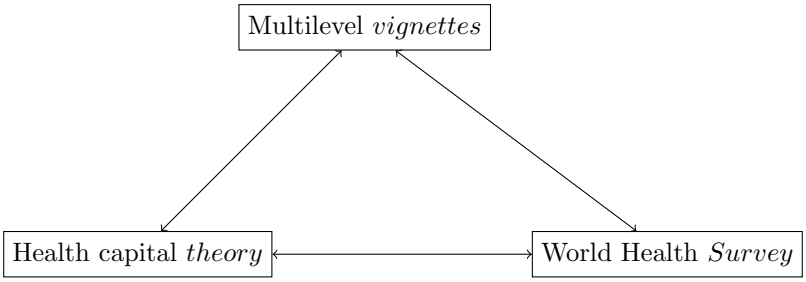

Fig. 1. Elements of solid comparative research on health inequalities.

As presented in Figure 1, solid comparative cross-national research can be realised if three underpinning elements are used [Harkness et al., 2003, Üstün et al., 2003]: strong substantive theory, modern statistical method (such as anchoring vignettes) and well designed survey. With the influential theory of health capital due to Grossman [1972], multilevel anchoring vignettes modelling and the WHO World Health Survey, my objective is to robustly compare social inequalities of health status and determinants across the world. To achieve this, the paper has three aims:

- to develop further the widely used anchoring vignettes modelling by including random intercepts to capture the multilevel (cross-national) differences,
- to apply my recent extension (incorporating causal effect of social capital) to the theory of health capital [Tampubolon, 2009a,b],
- to use the extended (random effect) vignette modelling and the new health capital theory to compare cross-national health inequalities in the domain of mobility in 48 countries with over 160,000 respondents.

The rest of the paper details the three elements in Figure 1, followed by results and discussion.

2. Multilevel anchoring vignettes modelling for comparative cross-national study

Although the World Health Survey has been widely used in the last few years, the full potential of comparative cross-national health inequalities have only been partially realised since participating countries have not been put on an even keel. Each country is either treated as fixed or aggregated in a pooled sample.

A random effect extension to vignettes modelling will allow all countries to be compared efficiently. This random effect approach will lead to new and robust conclusions about social inequalities of health in the world.

Often health status is elicited with question having fixed ordered response e.g. poorly, fair, good, or excellent [Wilkin et al., 1992]. In vignettes modelling

[Kapteyn et al., 2007, King et al., 2004, Salomon et al., 2004, e.g.] individual health status or outcome h_{io} is modelled as follows:

$$h_{i0} = \beta X_i + \epsilon_i \tag{1}$$

The residuals ϵ are standard normal or logit random variates giving ordered probit or ordered logit models, respectively. Importantly, the observed health status responses $s = 1$ (poorly), ... S (excellent), are generated via a threshold model with person specific set of thresholds τ_i^s for the latent health status h_{io}^*:

$$h_{i0} = s \quad \text{if} \quad \tau_i^{s-1} \leq h_{i0}^* < \tau_i^s \tag{2}$$

where $-\infty = \tau_i^0 < \tau_i^1 < \ldots < \tau_i^S = \infty$, and

$$\tau_i^1 = \gamma^1 V_i \tag{3}$$

$$\tau_i^s = \tau_i^{s-1} + \exp(\gamma^s V_i) \quad s = 2, \ldots, S \tag{4}$$

Individual covariates explaining health status X_i may overlap with thresholds covariates V_i.

To anchor the individual health status against the vignettes or short stories of health situations, a true health status θ_j of the person in vignette j is assumed. The perception of the individual respondent differs from this by a random error $u_{ij} \sim F$ to give $Z_{ij}^* = \theta_j + u_{ij}$. Likewise the observed responses to the vignettes are generated by the same threshold model above.

This leads to, in proportional odds ordered logit for instance,

$$\log \frac{\Pr(h_{i0} > s | X_i, V_i)}{\Pr(h_{i0} \leq s | X_i, V_i)} = \beta X_i - \tau_s, \tag{5}$$

for the individual-based health inequalities after vignettes anchoring for individual heterogeneity in assessing health status (reflected in conditioning on V_i). Model of this kind, also known as compound hierarchical ordered probit, has been fruitfully used for vignettes modelling of health status [Bago d'Uva et al., 2006].

To enable comparative cross-national study of health inequalities, I capture the multilevel structure of the World Health Survey and introduce random intercepts. The random intercepts reflect country shift in mean health status.‡

‡Instead of positing countries mean health status as shifting along a dimension, one can posit countries as belonging to families based on the similarities of their mean health status or patterns of health care deliveries. This is important from global public health perspective since there are similarities as well as differences in health system performance across countries in the world [Murray and Evans, 2003]. The health status levels of families of nations thus form a finite mixture or latent class. This final specification changes (5) to

$$\log \frac{\Pr(h_{i0} > s | X_i, V_i, \kappa_k)}{\Pr(h_{i0} \leq s | X_i, V_i, \kappa_k)} = \beta X_i + \sum_1^N \kappa_n \nu_{nk} - \tau_s \tag{6}$$

where ν_{nk} is one of the $N - 1$ indicators (1 if country k belongs to country family n and otherwise 0). The κ parameters now capture the differences between families of nations in average health. This is the subject of my further investigation.

Then (5) becomes

$$\log \frac{\Pr(h_{i0} > s|X_i, V_i, \kappa_k)}{\Pr(h_{i0} \leq s|X_i, V_i, \kappa_k)} = \beta X_i + \kappa_k - \tau_s \tag{7}$$

where $\kappa_k \sim N(0, \sigma_\kappa^2)$ and are independent of ϵ_i.

Another methodological extension to the common anchoring vignettes tries to relax the assumption of unidimensionality. For this paper, I maintain this assumption.

The next element in Figure 1 underpins the substantive issues, that is the theory of health capital incorporating neighbourhood context.

3. Theory of health capital linking community social capital and individual health inequalities

This section is from Tampubolon [2009b] which builds on an influential theory of health capital due to Grossman [1972]. Works on social inequalities of health by sociologists, epidemiologists and public health professionals can be bridged with works on health capital by health economists. I build this bridge by recognising the importance of community factors in theories used by both groups of scholars. In building this bridge, the Grossman theory of health capital is extended to include community factors especially the community social capital. Sociologists, epidemiologists, public health professionals and economists can fruitfully use community deprivation and social capital in deepening their understanding of health inequalities. My aim in this project is to test this extended theory of health capital to the world wide sample.

The extended model is presented in Figure 2 where it shows that processes determining health are not circumscribed entirely within the individual. The processes also involve community social capital.

Adopting 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

$$H_{t+1} = \theta m_t + (1 - \delta_t) H_t \tag{8}$$

where m_t is the decisions and behaviours for maintenance of health (including medical care bought and Grossman's health promoting activities undertaken), 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

$$U = \sum_0^T (1 + \rho)^t \nu(c_t, H_t) \tag{9}$$

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

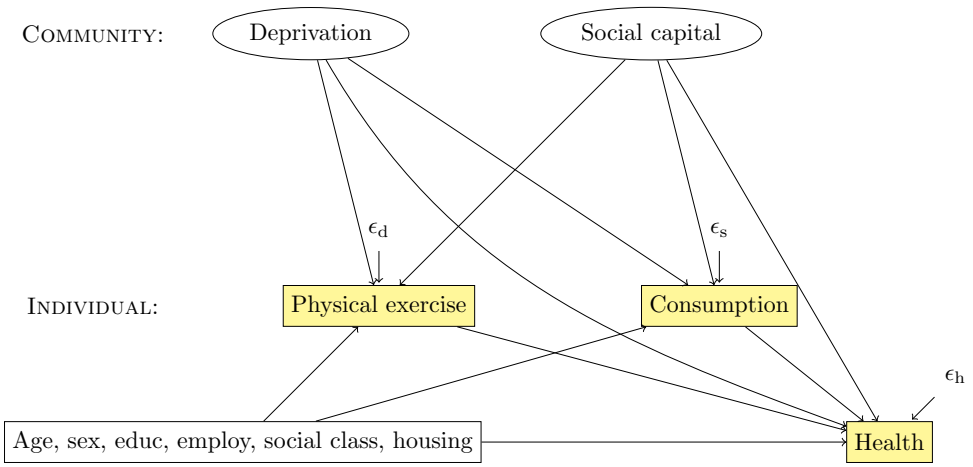

Fig. 2. Theory of health capital explaining individual health behaviours (eg exercise) and health accounting for shared community deprivation and social capital.

limits:

$$\sum_{0}^{T} \frac{c_t}{(1+r)^t} + \sum_{0}^{T} \frac{p_m m_t}{(1+r)^t} = W_0 + \sum_{0}^{T} \frac{y_t(H_t)}{(1+r)^t} \tag{10}$$

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 issues like the role of education and inequalities in health. They have often been tested empirically by assuming functional forms for the elements of the theory. Wagstaff, Dustman and Windmeijer provide some example assumptions which enable empirical estimation. Thus empirical equations for health production function and for health maintenance are:

$$H = H(M, W, X, \mu_h) \tag{11}$$

and

$$M = M(W, Y, \mu_m) \tag{12}$$

where W is wealth, X and Y include age, education and exogeneous variables. The last equation contains exclusion restriction (family size in Grossman's case), and the μ's are residuals.

I propose an extension broadening the model to include community 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 risks which

affect health then we are in a position to include community effects through non-market interaction. The benefits of this extension include increased scope of explanation and intervention.

Theoretical justification for including broader actions, specifically neighbours' actions, on resident's individual health is grounded in recent works on non-market interaction [Glaeser et al., 2002, Cutler and Glaeser, 2005, Durlauf and Fafchamps, 2005, Glaeser and Scheinkman, 2001, 2003, Becker and Murphy, 2000, Young, 1998, Arthur et al., 1997]. Glaeser and Scheinkman [2003] examine the condition giving rise to amenable multiple discrete equilibria (away from continuous equilibria) in non-market interaction model.

Typically, a non-market interaction model of felicity for individual i, $\nu^i(a_i, Z_i, \theta)$, has the elements of individual action, a_i, function of moments of community (or reference group) actions (usually negative), Z_i, and a shock to the felicity function, θ, as a result of taking the action. The roles of the first and last elements are obvious; the second element captures sanction from deviating from the norm or encouragement from reinforcing the norm.

Brock and Durlauf (1995) for instance use the following global non-market interaction model (see also Aoki [1995]).

$$V = m_i + J(1 - \mathbf{Z}_i)^2 + \epsilon(1 - m_i) \tag{13}$$

where m is the maintenance of health action, J is the penalty intensified by deviation from community average or norm of action $\mathbf{Z}_i$ and ϵ is a taste shock. Essentially the second term is a function of community moment reflecting the fact of community norm (statistically, function of community moments) should have an effect on individual action.

Obesity can be used as an illustration. 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 non-market interaction. What one orders to begin with ("Just a salad for me." Or "The full monty, please") and what one finishes, a_i, is not unrelated to what everyone else around the table order or finish, Z_i. This scene extends, with attenuation, over to the community 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, this network of friends led to increase in obesity through this non-market interaction. The authors were careful to account for individual socio-demographic factors and other place factors.§ Tampubolon et al. [2009] find, in a national sample in Wales, that friendly neighbours and communities also lead to increase in obesity. The authors separate out the effect of individual sociodemographic and geographic factors in a multilevel multiprocess model which simultaneously explain consumption, physical exercise and obesity.

Glaeser and Scheinkman show that, for estimable hence desirable discrete equilibria, it is sufficient that the second derivative of felicity with respect to

§Cohen-Cole and Fletcher [2008] question the result but see also the rejoinder by Christakis and Fowler in the same issue.

one's own action is greater than partial cross-derivative between one's own action and the community's action. This they term moderate social influence condition (:340, 352). It means the effect of one's action on one's self must be greater than the induced effect through non-market interaction on one's neighbours.

Again, using obesity as an illustration: jogging by an individual should improve the individual's body mass composition. 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 using smoking (a health risk) as an illustration: smoking by an individual harms the individual's health. This deleterious effect should be more severe than induced harm in the health of the neighbours through either passive smoking or through non-market 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.

Notably, this moderate social influence condition is consistent with the basic tenet of epidemiology or public health research [Rose, 1992]. It is well known that community effect of health behaviour (its regression coefficient in ecologic regression where the unit of analysis is communities, not individual) 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 is typically 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 an individual.

In parallel to theoretically recognising the importance of non-market interaction, it is practicaly acknowledged that built and social features of community can induce benefits as well as pose risks of health, e.g. Srinivasan et al. [2003]. The recursive system (equations 4 & 5) incorporating insights from non-market interaction needs to be modified by including community effects such as community deprivation and community social capital, Z, in both health production function and maintenance demand:

$$H = H(M, Z, W, X, \mu_{hij}, \epsilon_j) \tag{14}$$

and

$$M = M(Z, W, Y, \mu_{mij}, \epsilon_j) \tag{15}$$

where ϵ's are the community residual. The individual residuals (μ_h and μ_m) now gain individual i and community j indices. Because community data are not available in this study, country data are used following Helliwell and Putnam [2004].

3.1. Social capital mechanisms

Since public health researchers first discovered and attempted to measure the effect of social capital on health a couple of decades ago, works on this effect have continued unabated. Different theoretical origins of social capital (Putnam, Coleman or Bourdieu) put great importance on the community or group or network aspects of social capital. A definition that will suffice for our purpose is due to Putnam (1993): "social networks and norms and trustworthiness" residing in a neighbourhood. Other more extended definitions are available and suitable for other purposes. Recent works have attempted to be more specific about how social capital influences health and well being.

In the most recent, wide ranging and systematic, review of empirical literature on community or neighbourhood social capital and health, Islam et al (2006) conclude that irrespective of whether or not one lives in an egalitarian country, individual social capital does have a positive association with better health. However, they also find that neighbourhood social capital matters less, if at all. One feature that is crucial in all empirical studies assessing the link between social capital and health is the predominance of studies from developed countries. These countries are relatively more egalitarian as indicated by their income distribution and by their public social expenditure. The authors suggest that this egalitarian feature is a major contributor to the weak effect of neighbourhood social capital as there is less need to rely on social capital when the state provides most of public health services. It is thus important to study the effect of social capital on health status using a wide range of countries.

But what is it about neighbourhood social capital that could be useful or harmful for individual health? Berkman and Kawachi [2000] write about mechanisms linking neighbourhood social capital and individual health. Two of these are emphasised: "access to local services and amenities is a [way] in which neighbourhood social capital may affect health ... and [neighbourhoods rich in social capital] are more successful at uniting to ensure access to health services." The mechanisms involve information exchange, support exchange and mobilisation. In these mechanisms, social capital is generally beneficial to health.

In contrast, a more recent study by Stafford et al. [2008] finds that social capital can be harmful to mental health. People with higher attachment to a neighbourhood tend to have higher odds of common mental disorders. However, the authors also find that people resident in a neighbourhood with more local friends have a lower odds of common mental disorders. Notably, both findings are confined to deprived neighbourhoods. There is no general effect of social capital, either positive and negative, found.

In parallel, a more recent study by Christakis and Fowler [2007] suggests that social network (an element of social capital) is a conduit of acceptable norm of body weight and of reasonable consumption behaviour. Health norms are construed and behaviours are induced in networks rich in social capital. Unfortunately, these norms and behaviours may have led to the spread of obesity over a period of decades.

The conceptual specification of mechanisms or what goes on in a neighbourhood has some significance. First, it reminds us that social process remains to

an important extent a spatial process. Second, not too long ago (see for instance Duncan et al 1993) neighbourhood effect is singularly inferred from the residual variance of the area random effect. If there is a positive residual variance then we are witnessing significant difference in 'the culture of smoking' or the culture of health under investigation. Metaphorically, it is a neat neighbourhood black box. As a major improvement, specifying these mechanisms is akin to conceptually clarifying what is going on inside the black box.

The last element in Figure 1 is the bespoke survey of health inequalities using vignettes, i.e. the World Health Survey.

4. The World Health Survey and anchoring vignettes

In 2002-2003, the World Health Organization initiated the World Health Surveys to monitor health outputs and outcomes using a "valid, reliable, and comparable household survey instrument" [Üstün et al., 2003]. For public health purpose, this survey is exceptional on three counts: comprehensive coverage of the world, theoretically informed, and methodologically geared to comparative cross-national analysis through the use of anchoring vignettes.

Countries from all the regions of the world are covered – Africa, Central and South America, Europe, Middle East, Asia and Australia. The conspicuous exception is the US.

For cross-national comparability, special emphases of the surveys were put on the health status description and health system responsiveness. Essential to achieve this guarantee is the use of the anchoring vignettes. Information in the individual part cover socio-demographics, health status description, health status valuation, risk factors, mortality, coverage of health intervention, health system responsiveness, health system goals, and interviewer observations.

Individuals were presented anchoring vignettes when health status description information was collected. Self-assessed health status were elicited for eight domains of health – mobility, self-care, pain and discomfort, cognition, interpersonal activities, vision, sleep, and energy & affect. For this study, mobility health vignettes are used as the dependent variables (higher values means more mobility problems or worse health status).

The self report and the five vignettes are as follows:

> Now I would like to review different functions of your body. When answering these questions, I would like you to think about the last 30 days, taking both good and bad days into account. When I ask about difficulty, I would like you to consider how much difficulty you have had, on an average, in the past 30 days, while doing the activity in the way that you usually do it. By difficulty I mean requiring increased effort, discomfort or pain, slowness or changes in the way you do the activity. Please answer this question taking into account any assistance you have available. Overall in the last 30 days how much difficulty did you have with moving around?
>
> [Mary] has no problems with walking, running or using her hands,

> arms and legs. She jogs 4 kilometres twice a week. Overall in the last 30 days, how much of a problem did [name of person] have with moving around? 1:None, 2:Mild, 3:Moderate, 4:Severe, 5:Extreme
>
> [Anton] does not exercise. He cannot climb stairs or do other physical activities because he is obese. He is able to carry the groceries and do some light household work. Overall in the last 30 days, how much of a problem did [name of person] have with moving around?
>
> [David] is paralyzed from the neck down. He is unable to move his arms and legs or to shift body position. He is confined to bed. Overall in the last 30 days, how much difficulty did [name of person] have with moving around?
>
> [Rob] is able to walk distances of up to 200 metres without any problems but feels tired after walking one kilometre or climbing up more than one flight of stairs. He has no problems with day-to-day physical activities, such as carrying food from the market. Overall in the last 30 days, how much difficulty did [name of person] have with moving around?
>
> [Vincent] has a lot of swelling in his legs due to his health condition. He has to make an effort to walk around his home as his legs feel heavy. Overall in the last 30 days, how much of a problem did [name of person] have with moving around?

Independent variables are age and gender at the individual level and, at the country level, Gross Domestic Product (GDP) per-capita and social capital measured by average of general trust in other people. GDP is used to capture level of development of the country and the figures are taken from the World Development Indicators 2001. Average general trust are taken separately from the World Values Survey 2005. There are 48 countries in the match between the World Health Survey and the World Values Survey and 162,239 respondents with mobility vignettes.

5. Result and Discussion

The structural part refers to the effect on latent mobility health dimension that is comparable across countries, whereas the measurement part refers to the relationship between the vignettes and the latent mobility. This relationship is captured in a set of loadings. Both are presented in Table 1. As age increases mobility problems also increase by 0.0612; women compared to men tend to have less mobility problems. At the country level, wealthier countries tend to have less mobility problems but the magnitude of the effect is miniscule. Social capital at the country level, the main substantive focus of this study, tends to reduce the magnitude of the mobility problem by a about half a point.

There remains a significant residual variance at the country level; this is perhaps due to other unobserved country or cultural factors unaccounted for in this

estimation. It is evident that anchoring vignettes do not absorb all cross-country and cross-individual unobserved differences. Anchoring vignettes capture, primarily, cross-individual differences, for which they are designed. Residual variance at the country level may capture unobserved differences between countries. This (extended) random effect anchoring vignettes model thus captures both sources of randomness.

The three elements underpinning cross-country comparative study: i.e. health capital theory, bespoke survey, and anchoring vignettes, are used to examine the effect of social capital on mobility. To examine this effect across country, mobility measure is anchored using a handful of vignettes or short stories of mobility situations. I find that for the 48 countries in the World Health Survey, social capital level in the country is inversely related with mobility problems of its residence, while controlling for age, gender and development stage of the country.

This finding confirm that of Helliwell and Putnam [2004], among others. In their estimation, they use self report of general health status (Likert scale 1 to 5) available in the World Values Survey in the late 1990s. The use of two independent sources of data (WHS for mobility health dimension and WVS for trust or social capital) is preferred compared to the use of one source of data for both health status and trust. In the latter, it would be difficult to discount the effect of unobserved individual disposition affecting both health status and trust. This is a well known problem also recognised e.g. by Helliwell and Putnam [2004, :1437].

The use of anchoring vignettes on a well-designed cross-country survey such as the World Health Survey advances our understanding about the effect of community or country social capital on health. First, we know in a bit more detail that one of the features of self-reported general health that is improved by social capital is mobility. This is important as a step in unpacking the concept of general health further with a view towards devising more appropriate intervention. Some mechanisms that people have identified [Kawachi and Berkman, 2000] linking community social capital and individual health may work more effectively through one dimension of health than through another, say mobility dimension versus energy/vitality dimension. This unpacking of general health status, more over, allows for the possibility that finds social capital to be detrimental to health. Christakis and Fowler [2007] for instance found that social network or capital may be implicated in the rise of obesity in Framingham, greater Boston. In sum, much like social capital itself is being made more amenable to better or distinct measurements, in parallel, health status is also being unpacked into its various dimensions. This combination can lead to a richer understanding of the pathways between country or community social capital and individual health.

Second, cross-country comparison of health status is always fraught with comparability problems [Harkness et al., 2003]. Anchoring vignettes is but one of the more useful methods in ensuring comparability. The results of this study strengthen the substantive finding mentioned above about the beneficial effect of social capital. Put differently, these results strengthen, if not validate, both the new method and the substantive claim about social capital.

There are at least three methodological lessons or implications learned from

Table 1. Social capital and mobility health dimension (plus vignettes) in 48 countries, World Health Survey

Variable	Coeff.	Std error	p
Age	0.0612	0.0028	< 0.0001
Female	-0.6434	0.0338	< 0.0001
Social capital	-0.4137	0.0236	< 0.0001
GDP	-0.0001	0.0000	< 0.0001
Constant	-2.5933	3.7086	0.48
$\sigma^2_{country}$	0.5806	0.0255	< 0.0001
λ			
vignette0(1)	5.1359	14.6262	0.73
vignette0(2)	5.9330	10.9317	0.59
vignette0(3)	6.0584	7.2666	0.40
vignette0(4)	4.1132	3.6216	0.26
vignette0(5)	0.0000	.	.
vignette1(1)	3.8995	0.7061	< 0.0001
vignette1(2)	1.9713	0.5321	0.0002
vignette1(3)	1.8530	0.3582	< 0.0001
vignette1(4)	1.1663	0.1879	< 0.0001
vignette1(5)	0.0000	.	.
vignette2(1)	-0.2730	0.4292	0.52
vignette2(2)	0.6889	0.3220	0.032
vignette2(3)	1.3372	0.2151	< 0.0001
vignette2(4)	1.3650	0.1092	< 0.0001
vignette2(5)	0.0000	.	.
vignette3(1)	-2.9122	0.0785	< 0.0001
vignette3(2)	-3.0126	0.0628	< 0.0001
vignette3(3)	-2.5460	0.0441	< 0.0001
vignette3(4)	-1.0583	0.0225	< 0.0001
vignette3(5)	0.0000	.	.
vignette4(1)	2.0295	0.6317	0.0013
vignette4(2)	2.4339	0.4749	< 0.0001
vignette4(3)	2.5085	0.3183	< 0.0001
vignette4(4)	1.4801	0.1636	< 0.0001
vignette4(5)	0.0000	.	.

Table 2. Social capital and self-reported mobility health dimension in 48 countries, World Health Survey

Variable	Coeff.	Std error	p
Age	0.0226	0.0003	< 0.0001
Female	-0.2462	0.0071	< 0.0001
Social capital	-0.0852	0.0050	< 0.0001
GDP	-0.0001	0.0000	< 0.0001
$\sigma^2_{country}$	0.2063	0.0026	< 0.0001

this study. First, the design and conduct of survey seems to be even more important when anchoring vignettes are fielded. There are a large proportion of missing item responses on the vignettes (sometimes nearly 80%). Although maximum likelihood estimator gives consistent estimates in the missing completely at random case as assumed here, this magnitude raises questions about the possibility of eliciting useful anchoring vignettes. A type of sensitivity analysis was conducted where a random intercept ordered logit was done on the self-report mobility alone. The result shows similar pattern (Table 2), and hence the anchoring vignettes results are robust in this case. It nevertheless registers the importance of design and conduct of survey containing anchoring vignettes so that the survey only places reasonable burden on the respondents. For instance, the English Longitudinal Study of Ageing uses only four instead of five vignettes; additionally, reducing the scales from five to four may also reduce the burden on the respondents.

Second, investigators handling self-report and vignettes responses often need to consider whether the self-report and the vignettes together make up one dimension. This is a question worthy of further investigation. The threshold gradients of some vignettes above certainly raise the possibility of more than one dimension. Again, this puts added importance on the design or choice of anchoring vignettes.

Third the computation is heavy and subject to local maxima. A single run takes up nearly 18 hours with Latent Gold [Vermunt and Magidson, 2006]. Random local starts are always advised in this context [Vermunt and Magidson, 2006, Muthén and Asparouhov, 2009] and this makes computation intensity felt more acute. This intensive computation is expected since the original developers of anchoring vignettes note that cross-country comparison using anchoring vignettes is computationally costly [Tandon et al., 2003, :740]. However, given that it uncovers comparable estimate of inequality in specific dimension of health, this is a cost worth paying.

6. Conclusion

Applying random intercepts anchoring vignettes model to cross-national comparative survey of health has substantial and methodological payoffs that may be related. The claim that country or community social capital may be beneficial for individual health has been confirmed in this case. Two methodological elements increase our confidence in the results: anchoring vignettes model ensures

health status across countries are put on an even keel while random intercepts absorb unobserved country specific or cultural factors.

Country and community social capital maybe beneficial not only for general health status but also for specific domains of health i.e. mobility. Although, it must be noted that other domains may display different relationship with social capital. It is now possible however to examine these different domains in detail in a robustly comparable manner across large number of countries thanks to random intercepts anchoring vignettes.

References

M. Aoki. Economic fluctuations with interactive agents: Dynamic and stochastic externalities. *The Japanese Economic Review*, 46(2):148–165, 1995.

W. B. Arthur, S. N. Durlauf, and D. A. Lane, editors. *The Economy As An Evolving Complex System II*. A proceedings volume in the Santa Fe studies in the sciences of complexity. Addison Wesley, 1997.

T. Bago d'Uva, E. van Doorslaer, M. Lindeboom, O. O'Donnell, and S. Chatterji. Does reporting heterogeneity bias the measurement of health disparities? Working Paper 06/03, University of York, 2006.

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

L. F. Berkman and I. Kawachi, editors. *Social Epidemiology*. Oxford University Press, Oxford, UK, 2000.

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

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

E. Cohen-Cole and J. M. Fletcher. Is obesity contagious? Social networks vs. environmental factors in the obesity epidemic. *Journal of Health Economics*, 27(5):1382–1387, September 2008.

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

S. N. Durlauf and M. Fafchamps. Social capital. In P. Aghion and S. N. Durlauf, editors, *Handbook of Economic Growth*, volume 1, chapter 26. North Holland, Amsterdam, 2005.

E. L. Glaeser and J. A. Scheinkman. Measuring social interactions. In S. N. Durlauf and H. P. Young, editors, *Social Dynamics*, pages 83–131. MIT Press, Cambridge, MA, 2001.

E. L. Glaeser and J. A. Scheinkman. Nonmarket interactions. In M. Dewatripont, L. P. Hansen, and S. J. Turnovsky, editors, *Advances in Economics and Econometrics: Theory and Applications, Eighth World Congress*, volume I, pages 339–369. Cambridge University Press, Cambridge, 2003.

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

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

J. A. Harkness, F. J. R. vand de Vijver, and P. P. Mohler. *Cross-cultural Survey Methods*. Wiley, Hoboken, NJ, 2003.

J. F. Helliwell and R. D. Putnam. The social context of well-being. *Philosophical Transactions of the Royal Society of London*, 359:1435–1446, 2004.

A. Kapteyn, J. P. Smith, and A. van Soest. Vignettes and self-reports of work disability in the United States and the Netherlands. *American Economic Review*, 97(1):461–473, March 2007.

I. Kawachi and L. F. Berkman. Social cohesion, social capital, and health. In Berkman and Kawachi [2000].

G. King, C. J. L. Murray, J. A. Salomon, and A. Tandon. Enhancing the validity and cross-cultural comparability of measurement in survey research. *American Political Science Review*, 98(1), 2004.

C. J. L. Murray and D. B. Evans, editors. *Health Systems Performance Assessment: Debates, Methods and Empiricism*. World Health Organization, Geneva, 2003.

B. Muthén and T. Asparouhov. Multilevel regression mixture analysis. *Journal of the Royal Statistical Society, Seris A*, 172(3):639–657, 2009.

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

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

J. A. Salomon, A. Tandon, and C. J. L. Murray. Compatibility of self rated health: Cross sectional multi-country survey using anchoring vignettes. *British Medical Journal*, 328(7434):258–260, 2004.

S. Srinivasan, L. R. O'Fallon, and A. Drearry. Creating healthy communities, healthy homes, healthy people: Initiating a research agenda on the built environment and public health. *American Journal of Public Health*, 93(9):1446–1450, September 2003.

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

G. Tampubolon. Neighbourhood social capital improves individual health quality of life in a national sample from Wales. Working papers, University of Manchester, 2009a. URL `http://mpra.ub.uni-muenchen.de/16758/`.

G. Tampubolon. Neighbourhood social capital and individual mental health. Working papers, University of Manchester, 2009b. URL `http://mpra.ub.uni-muenchen.de/16778/`.

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

A. Tandon, C. J. L. Murray, J. A. Salomon, and G. King. Statistical models for enhancing cross-population comparability. In Murray and Evans [2003].

T. B. Üstün, S. Chatterji, A. Mechbal, C. J. Murray, and W. C. Groups. The World Health Survey. In Murray and Evans [2003].

J. K. Vermunt and J. Magidson. *The Latent GOLD 5 Syntax module*. Statistical Innovations Inc., Belmont, MA, 5 edition, 2006.

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

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