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Healthy by Association:

The effect of social participation on self-rated physical and psychological well-being

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Keywords: social participation, physical health, psychological health, British Household Panel Survey

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Abstract

This paper investigates the effect of active social participation on individual self-rated physical and psychological well-being. The theoretical model shows that individual's health investment increases if he invests time in health enhancing social activities. Using longitudinal data from the British Household Panel Survey (BHPS), we show that being an active member of social and/or sports associations increases self-rated physical and psychological well-being. For men the beneficial effect of social interaction works mostly via physical pathways, while women report a more psychosocial effect. Manual workers have a higher physical and psychological relief associated with social interactions while non-manual workers find higher relief associated with sports participation. Such effects are decreasing in the number of association the individual is active in. Policy concerns should be aimed in either fostering health enhancing leisure time health activities or in increases positive social bonding.

JEL-Classification: D91, I12, I18, Z13

" No man is an island, entire of itself; every man is a piece of the continent, a part of the main' [...] Man is a social being that cannot exist without his fellows. No one is self-sufficient and everyone relies on the other for successful survival."

John Donne, Meditation XVII, 1624

1 Introduction

Over the last 20 years the social interaction structure changed dramatically. Individuals are now less likely to develop social relationships outside their families (Putnam, 1995, 2001). Many are isolated and talk to no one about matters they consider important. People reporting no one with whom they discuss important matters nearly tripled and the mean network size decreases by about a third (i.e. one friend)(McPherson et al., 2008). Both family and non-family peers were lost, but the greater decrease of non-family ties leads to more confidant networks centered on spouses and parents, with fewer external contacts. The largest losses have come from the ties that binds individuals to the community. The loss in time spent socializing might be related to the change in working schedule and the opportunity cost of time, making more costly to undertake health-producing activities that are time-intensive and harder to plan since they are shared with friends (Campbell, 2002, Burton and Turrell, 2000, Kouvonen et al., 2005).

This increases in social fragmentation poses serious health concerns. In fact engaging in social activities is a critical input for improving physical, mental and cognitive health (House et al., 1988, Tominaga et al., 1998, Gump and Matthews, 2000, Ryff et al., 2004, Cohen, 2004, Uchino, 2006, Umberson and Montez, 2010). Individuals who participate in a social network are subject to social controls and peer pressures which influence normative health behaviors or more generally provides a social reinforcement for the investment and production of health (House et al., 1988, Cohen, 2004, House, 2001, Uchino, 2006, Umberson and Montez, 2010). Social ties creates a protective effect for individuals' psychological and physical health. Social relationship, in fact, is able to protect health by moderating or buffering potentially deleterious health effects of psychosocial stress or other health hazards via social support and community integration (House et al., 1988, Lindström and Giordano, 2016). For example, social networks influence whether individuals exercise, eat low-fat diets, smoke, or make use of drugs. Integration may also foster feelings of responsibility for others resulting in increased motivation to take care of oneself so that self-responsibility can be enhanced. Having a wide range of network ties also provides multiple sources of information that could influence health-relevant behaviors, result in more effective use of available health services, or avoid high-risk situations and behaviors. Various studies Pressman et al. (2009), Kenkel (1995), Sickles and Yazbeck (1998), Contoyannis and Jones (2004) show that a wide variety of social activities are associated with psychosocial and physical measures relevant for health and well-being such as level of stress and depression, blood pressure, total cortisol, waist circumference, and body mass index. Social isolation, on the other side, could be a stressor in its own right, increasing the sense of alienation, loneliness, and stress while decreasing feelings of control and self-esteem. In turn, these negative psychological states could increase neural and cardiovascular responses, suppress immune function, and interfere with performance of health behaviors (Cacioppo et al., 2002, House et al., 1988, House, 2001). The magnitude of risk associated with social isolation is comparable with that of cigarettes smoking and other major biomedical and psychosocial risk factors (House, 2001).

Several studies found a positive association between social capital and health. McCulloch (2001), Lindström (2004) studied the relationship between social capital and self-reported psychological health, the first one used neighborhood problems as a proxy for social capital, while Lindström (2004) employed social par-

ticipation measured as trust. Bassett and Moore (2013), instead, investigated the link between depressive symptoms and social network size. In addition to such evidence there are also other papers studying the effect of social capital and health using longitudinal data (Lindström and Giordano, 2016, Giordano and Lindström, 2011). Giordano and Lindström (2011) investigated on the link between social capital, measured by interpersonal trust, active social participation, frequency of talking with neighbors, and changes in self-rated psychological health; while Lindström and Giordano (2016) compared the buffering effects of generalized trust and social participation against worse psychological wellbeing during and after the 2008 financial crisis.

The present paper aims to study the longitudinal relationship between active social participation and self-related physical and psychological health, from a theoretical and empirical point of view. Our contributions are threefold. First of all we provide a theoretical model, with testable implications, regarding the possible effects of social capital on health. Secondly we exploit a longitudinal data and fixed effect (FE) model to study the causal relationship between social participation and physical and mental health. By using individual fixed effects we can control for individual unobservable characteristics influencing their choice of being socially active. Lastly we use a specific classification of social capital, active membership to social or sport associations. By focusing on active participation we are able to isolate the effect of social capital for individual whom deliberately decide to being socially and identify their actual social structure, in order to investigate how this affect their health. The results from the theoretical model show that individual's health stock increases if he invests time in health enhancing social activities. Using longitudinal data from the British Household Panel Survey (BHPS), from 1991/92 to 2007/08, we measure physical health as the probability of reporting poor/fair overall health and mental health with the Likert scale of the reduced version of the Generalized Household Questionnaire (GHQ). In addition to this we also explore the effect of the number of associations active in to health. Using a fixed effect model, we show that being an active member of social and/or sports associations increases self-rated physical and psychological well-being. The results divided for gender shows that the beneficial effects from social participations works for men mostly via a more physical pathways with respect to women that report a more psychological effect. Additionally, the results from job type stratification show that manual workers have a higher physical and psychological relief associated with social interactions while non-manual workers find higher relief associated with sports participation. Such effects are decreasing in the number of association the individual is active in, showing a decreasing return on social membership on health, especially for men and manual workers. Policy effort should be devoted in fostering social participation to increases individual health investment.

2 The Model

Assume that the individual derive utility from, own health, H_t, some other commodities consumption, Z_t, but also from the "friends" consumption, C_F

$$u_t = u(H_t, Z_t, C_{t,F}) \tag{1}$$

where $u(.)$ is a well-behaved utility function. The individual stock of health depreciates over time, but the individual can invests in health to offset such depreciation

$$\frac{\partial H_t}{\partial t} = I_t - \delta_t H_t \tag{2}$$

where δ_t is assumed to be the rate of depreciation of health. The individual produces gross investment in health (I_t)

$$I_t = (M_t, t_{t,H}, X_{t,F}, t_{t,F}) \tag{3}$$

and other commodities

$$Z_t = (X_{t,Z}, t_{t,Z}) \qquad C_{t,F} = (X_{t,F}, t_{t,F}) \tag{4}$$

where M_t and $X_{t,i}$, with $i = Z, F$ are market goods and $t_{t,H}$, $t_{t,Z}$ and $t_{t,F}$ are own time used in the production of health, spent with friends and in the production of other commodities[1]. The individual can use the input for the production of friends' consumption both as a direct consumption good but also as an input for the production of health.

Individual's stock of wealth (W_t) will develop over time

$$\frac{\partial W_t}{\partial t} = rW_t + \omega_t(H_t, E_{t,\omega})t_{t,\omega} - p_t M_t t_{t,M} - q_t X_t t_{t,X_i} \tag{5}$$

r is the market interest rate, ω_t is the wage rate, $E_{t,\omega}$ is the level of education and on-the-job gaining, $t_{t,\omega}$ is work time and p_t and q_t are the prices for medical care (M_t) and other goods (X_t). Health will affect income in two ways: (1) trough its effect on the wage rate; (2) trough its effect on healthy time available to work. $\omega_t(H_t, E_{t,\omega})$ can be thought as the labor market earning rate of return on human capital.

The available amount of healthy time in each period is total time (T) less time spent sick ($t_{t,S}$), which is assume to be a decreasing function of the amount of health capital of individuals

$$t_{t,S} = t_{t,S}(H_t) \qquad \frac{\partial t_{t,S}}{\partial H_t} < 0 \qquad \frac{\partial^2 t_{t,S}}{\partial H_t^2} > 0$$

Total time is

$$T = t_{t,\omega} + t_{t,H} + t_{t,Z} + t_{t,S} + t_{t,F} \tag{6}$$

[1]Both equation (3), (4) are assumed to be HD1 in goods and time inputs.

The individual problem is to choose the time path of M_t and X_t (controls) maximising lifetime utility

$$\begin{aligned}
\max_{M_t, X_{t,i}} U &= \int_t^T e^{-\beta t} u(H_t, Z_t, Ct, F) dt \\
\frac{\partial H_t}{\partial t} &= I_{t,H} - \delta_t H_t \\
\frac{\partial W_t}{\partial t} &= r W_t + \omega_t(H_t, E_{t,\omega}) t_{t,\omega} + B_t - p_t M_t - q_{t,i} X_{t,i} \\
T &= t_{t,\omega} + t_{t,H} + t_{t,Z} + t_{t,S} + t_{t,F} \quad \text{(time constraint)} \\
H(0) &= H_0, \quad W(0) = W_0 \quad \text{(given)} \\
H(T) &= H_T \leq H_{min}, \quad W(T) = W_T \geq 0, \quad W_T^* \lambda_{T,W} = 0
\end{aligned} \tag{7}$$

where U is the individual's intertemporal utility function (discounted value of the individual's lifetime utility) discounted by the individual's rate of time preference, β. H_{min} is the individual's "death stock" of human capital; the individual dies when health passes below some level H_{min} which determines T (time of death). The individual is free to lend and borrow capital, but the bequest (W_T) cannot be negative.

The solution to this horizontal-terminal-line problem (Chiang, 1992) gives that the individual invests in health until the marginal benefit of new health equals the marginal cost of health (see Appendix A)

$$\frac{\partial u_t}{\partial H_t}\left(\frac{e^{-\beta t}}{\lambda_{t,W}}\right) + t_{t,\omega}\frac{\partial \omega_t}{\partial H_t} + \frac{\mu_t}{\lambda_{t,W}}\left(\frac{\partial t_{t,S}}{\partial H_t}\right) = \pi_t\left[\delta_t + r - \frac{\partial \pi_t}{\partial t}\frac{1}{\pi_t}\right] \tag{8}$$

Since from (B.8) we have that $\lambda_{t,H} = \lambda_{t,W} r$, in periods when the budget constraint is binding ($\lambda_{t,W}$ high) or when the effective price of care is high (π_t), $\lambda_{t,H}$ will be high, implying that the individual's stock of health will be low.

From (A.13) we get the time path of $\lambda_{t,H}$

$$\frac{\partial \lambda_{t,H}}{\partial t} = \lambda_{t,H}\delta_t - t_{t,\omega}\frac{\partial \omega_t}{\partial H_t}\frac{e^{-\beta t}}{\partial I_t / \partial X_{t,F}}\frac{\partial u_t}{\partial C_{t,F}}\frac{\partial C_{t,F}}{\partial X_{t,F}}\frac{1}{\pi_{t,F} - \pi_{t,M}} + \mu_t \frac{\partial t_{t,s}}{\partial H_t} - e^{-\beta t}\frac{\partial u_t}{\partial H_t} \tag{9}$$

which depends on:

- the rate of depreciation in health δ_t
- the sensitivity individual's wage rate to changed health conditions $\dfrac{\partial \omega_t}{\partial H_t}$
- individual's valuation of time [how binding is the time restriction (μ_t)]
- the efficient price of medical care and friends, π_M and π_F
- the effect of time consumption of friends' good on health $\partial I / \partial X_{t,F}$.

To analyse the possible effects of friend's association we assume that $\pi_F > \pi_M$, such that, for the same level of prices, the effect of medical care on health investment is higher than the effect of leisure time, making

medical care more health effective[2]. Then we derive the following relationships, depending on the type of friends' association:

1. Leisure time is a positive health investment i.e. $\partial I/\partial X_{t,F} > 0$.
    - The individual will invest more in health ($\lambda_{t,H} \downarrow$)
2. Leisure time is a negative health investment i.e. $\partial I/\partial X_{t,F} < 0$.
    - The individual will invest less in health ($\lambda_{t,H} \uparrow$)

Proposition 2.1 (Health by Association)**.** *Ceteris paribus the individual will invest more in health if leisure time is health enhancing.*

Whenever social interaction creates a positive health investment through, for example leisure time physical activity with friends, the individual will increase his health stock. The recent deconstruction of social structure can thus be directly linked to a decreases in health stock, due to a decrease in leisure time health increasing activities or to a substitution to more sedentary lifestyle (i.e. $\partial I/\partial X_{t,F} < 0$).

3 Data and methodology

3.1 Data

The analysis is based upon all the waves of the British Household Panel Survey (BHPS), from 1991/92 to 2007/08, where the information on social participation is available[3]. The BHPS is a longitudinal survey of households in Great Britain, including a rich set of information on occupational, socio-demographic and health variables. It contains observation about each adult member (16 years old or older) of a nationally representative sample of households. For our econometric analysis we use an unbalanced panel sample, containing all the available observations at each wave that provide complete information for the variables used in the model. The sample also includes new entrants to the survey. In order to be able to control for working time constraint we restrict our sample to working age individuals form 18 to 65 years old.

As dependent variables we use two health metrics: self-assessed physical health and psychological well-being. Similarly to Robone et al. (2008), in order to maintain the comparability of the self-assessed health across all waves we collapse the original categorization into a new one representing the following categories: poor or very poor, fair, good or very good, excellent. Then we derive a dummy variable coded one if the individual reported poor/very poor and fair health and zero otherwise. As a measure of psychological well-being, we use the reduced version of the General Household Questionnaire (GHQ) in the BHPS. For each

[2]Which is a reasonable assumption giving the higher healing capability of health care, in fact if we assume that the prices of medical care and leisure time are equal we have $\frac{p}{\partial I/\partial X_F} > \frac{p}{\partial I/\partial M}$ since $\frac{\partial I}{\partial M} > \frac{\partial I}{\partial X_F}$.

[3]The final pooled sample is composed by 15 wavs.

of the 12 items present in the GHQ[4], respondents are asked to indicate on a four-point scale (where 0 is the best scenario and 3 is the worst) how they recently felt in relation to each item. As a proxy for overall psychological well-being we use the Likert scale (Likert, 1952), which reports an overall score summing the individual components of the GHQ[5].

To measure social participation we exploit the fact that among all the questions contained in the BHPS there is also the record of how many social organizations the individual is either part or active in[6]. Since we are interest in measuring how being socially engaged affects health we focus on the social activities in which the individual is active in to construct two social participation dummies. The first one is a dummy variable coded one if the individual is active in any of the organization listed in the questionnaire, while the second is coded one if the individual is active in a sports club. In this way we are able to divide the possible positive health effect of social participation into a general components (i.e. active in any organization) and one related to physical fitness and sport participation (i.e. active in sport club). Intuitively we expected that the beneficial effect of sports participation to be higher than the generic attendance of a social association.

As an additional control for social participation we also use the number of social organization in which the individual is active. We include this last variable in square to address possible non-linearities of social participation.

In order to control for other factors that simultaneously affect individual health and his likelihood of being socially active we include several socio-demographical variables such as: age, highest educational level, marital status, household's tenure, number of visits to general practitioner (GP), log of net monthly income, socio-economic group of current job, weekly working hours and overtime. Year and regional dummies are included to account for aggregate health shocks.

Table 1 presents the mean for the variables used in our empirical models for the sub-samples of women, men and manual and non-manual workers. Overall we notice that male and non-manual workers have higher working/overtime weekly hours and are more active both in social and sports club with respect to female and manual job workers; they also tend to report higher physical and psychological health.

[Table 1 about here.]

3.2 Methodology

To analyze the effect of social participation on individual health we estimate equations in the fixed effect (FE) model:

$$h_{it} = \alpha_i + \beta X'_{it} + \gamma S_{it} + \theta_t + \epsilon_{it} \tag{10}$$

[4]The 12 items are: concentration, loss of sleep, playing a useful role, capable of making decisions, constantly under strain, problem overcoming difficulties, enjoy day to day activities, ability to face problems, unhappy or depressed, losing confidence, believe is self-worth, general happiness.

[5]The Likert scale, therefore, ranges from 0 to 36, where 0 is the best scenario and 36 is the worts.

[6]Such organizations are: political party, trade union, environmental group, parents association, tenants group, religious group, social group, sports club and women institute.

where h_{it} denotes the health indicator of individual i at time t (i.e. physical and mental health status); α_i is an individual fixed affect; X'_{it} is a set of individual time-varying characteristics (e.g. age, age squared, education, dummy for type of job, hours and over-time worked, log of wage rate, GP visits); S_{it} is a dummy variable for individual participation to social or sports associations, and in a given specification the numbers of social organization in which the individual is active in. We also include survey year fixed effects, θ_t, and a full set of regional fixed effects at the Government Office Region (GOR). We evaluated the robustness of our results using non-linear panel data methods, including a random effect Probit model (results available upon request). We stratify our analysis by gender and by type of job (manual vs. non-manual job).

4 Results

In this section we present the estimations of the empirical model described in the previous section. Table 2-6, report the result for the fixed effect models of equation (10), using longitudinal data from 1991/92 to 2007/08, for the probability of reporting poor-fair health (columns (1)-(3)) and the Likert scale of the reduced version of the GHQ-12 (columns (4)-(6)). In all tables columns (1) and (4) presents the effects on health of being active in social association; columns (2) and (5) the effects of being active in sports association and finally columns (3) and (6) the effects of the number of active organization. Overall the effects of social participation have the expected negative sign, which is association with an increases in self-rated health (i.e. a decreases in the probability of reporting poor/fair health and a decreases in the Likert scale) and are all statically significant throughout all specifications. Another noteworthy pattern that is consistent in all regression is that the number of associations in which the individual is active has a positive but decreasing effect.

[Table 2 about here.]

The results from the whole sample (Table 2), as expected, shows that being active in any sport associations yields a higher returns on health than being active in any social organization. Being an active member of a sports club produce a 4% reduction in the probability of report poor/fair health against a 3% reduction of just being socially active; such difference is still present but less pronounced for mental health where being socially active reduce the Likert scale by 0.5 while being active in sports association decreased by 0.4. The number of social associations the individual is active in have a positive effect on both the measure of health although at a decreasing rate.

[Table 3 about here.]

[Table 4 about here.]

Table 3 and 4 presents the results for men and female respectively. For both gender the health effects of being active in sport associations is higher than the one associated with being active in any social association.

The effects on physical health for men (columns (1) and (2), table 3) are slightly higher than the one reported for female (columns (1) and (2), table 3). For men being active in any organization reduces the probability of report poor/fair health of 4% versus 3% for women; the effects of sport participation is also higher for men (5% vs. 4.6%) although such difference is less pronounced. For what concern the effect of social participation on psychological health the pattern is reversed. In fact, women report a higher positive effects of social participation on health, both from being active in any organization (0.43 vs. 0.36 reduction in Likert scale) and sports club (0.5 vs. 0.4 reduction). This evidence shows that the beneficial effects from social participation works for men mostly via a more physical pathways with respect to women that reports a more psychological effect. This evidence might also be recollected to the fact that men are more likely than women in being active in sports club.

4.1 Social relief and working conditions

In this section we explore the possibility that working conditions are a discriminating variable for the magnitude and sign of social association effects on health. Individual undergoing different type of jobs seek different from of social association in order to gain physical and mental relief from work-related stress. To explore such possibility we divide our sample in manual and non-manual workers. In fact, depending from the type of stress they are exposed to, being socially active, either from social or sports club, is most certainly able to create different (positive) impacts on manual and non-manual workers. Manual workers, for example, might benefit from social support and/or sports activities shared with friends since the nature of their job is more isolating and repeated. Non-manual workers, on the contrary, have more socially active jobs and might find more relief from different leisure activities. In order to divide our sample of employed individuals in manual ad non-manual workers we exploit the socio-economic group provided in the questionnaire (i.e. *jbseg* in all waves) which explicitly categorizes jobs in manual and non-manual.

[Table 5 about here.]

[Table 6 about here.]

Table 5 and 6 presents the results for non-manual and manual workers respectively. Interestingly the positive effects of social and sport participation on physical health are higher for manual workers (columns (1) and (2), table 6) than for non-manual workers (columns (1) and (2), table 5). The effect of being active in any social organization decreases the probability of reporting poor/fair health for manual workers by 4% with respect to 2% reduction for non-manual workers; sports participation effects is also higher for manual worker (5% vs. 4%) although the difference is less pronounced. The effect of social participation in any organization on psychological well-being is also higher for manual workers (0.5 vs 0.3) reduction in the Likert scale by participation in any social organization), especially for sports participation (0.6 vs. 0.4). Overall these results shows that manual workers, which perform more repeated and strenuous jobs, have a higher physical and psychological relief associated with social interactions than individual engaged in non-manual

jobs, especially from being active in sports. Such findings supports the health supporting mechanism that social association plays, especially for individuals undergoing more isolating and physical demanding jobs.

5 Conclusion

The recent deconstruction of social network poses some serious concerns regarding not only the fall in individuals' social attitude but more importantly the effect that such increased isolation has on individual's health. In fact engaging in social activities is a critical input for improving physical, mental and cognitive health. Social networks influence whether individuals exercise, eat well, smoke or make use of drugs. In addition to this social integration may also foster feelings of responsibility to others resulting in increased motivation to take care of oneself. In this paper we study such association even further by using a theoretical model with testable implications and longitudinal data. Our contributions are threefold. First of all we provide a theoretical model, with testable implications, regarding the possible effects of social capital on health. Secondly we exploit a longitudinal data and fixed effect (FE) model to study the causal relationship between social participation and physical and mental health. By using individual fixed effects we can control for individual unobservable characteristics influencing their choice of being socially active. Lastly we use a specific classification of social capital, active membership to social or sport associations. By focusing on active participation we are able to isolate the effect of social capital for individual whom deliberately decide to being socially and identify their actual social structure, in order to investigate how this affect their health. The results from the theoretical model show that individual's health stock increases if he invests time in health enhancing social activities. Using longitudinal data from the British Household Panel Survey (BHPS), from 1991/92 to 2007/08, we measure physical health as the probability of reporting poor/fair overall health and mental health with the Likert scale of the reduced version of the Generalized Household Questionnaire (GHQ). In addition to this we also explore the effect of the number of associations active in to health. Using a fixed effect model, we show that being an active member of social and/or sports associations increases self-rated physical and psychological well-being. The results divided for gender shows that the beneficial effects from social participations works for men mostly via a more physical pathways with respect to women that reports a more psychological effect. Additionally, the results from job type stratification show that manual workers have a higher physical and psychological relief associated with social interactions while non-manual workers find higher relief associated with sports participation. Such effects are decreasing in the number of association the individual is active in, showing a decreasing return on social membership on health, especially for men and manual workers. Policy effort should be devoted in fostering social participation to increases individual health investment.

A Appendix A: Derivation of condition 9

The Lagrangian for solving this problem is (dropping time indexes for simplicity)

$$\mathcal{L} = u(.)e^{-\beta t} + \lambda_H[I_H(.) - \delta H] + \lambda_W[rW + \omega(.)t_\omega - pM - q_Z X_Z - q_F X_F] + \mu[T - \sum_{i=\omega,H,Z,S,F} t_i] \quad \text{(A.1)}$$

The first order conditions for an internal solutions are

$$\frac{\partial \mathcal{L}}{\partial M} = 0 \qquad \lambda_H \frac{\partial I}{\partial M} - \lambda_W p = 0 \quad \text{(A.2)}$$

$$\frac{\partial \mathcal{L}}{\partial X_Z} = 0 \qquad e^{-\beta t}\frac{\partial u}{\partial Z}\frac{\partial Z}{\partial X_Z} - \lambda_W q_Z = 0 \quad \text{(A.3)}$$

$$\frac{\partial \mathcal{L}}{\partial X_F} = 0 \qquad e^{-\beta t}\frac{\partial u}{\partial C_F}\frac{\partial C_F}{\partial X_F} - \lambda_W q_F + \lambda_H \frac{\partial I_H}{\partial X_F} = 0 \quad \text{(A.4)}$$

$$\frac{\partial H}{\partial t} = \frac{\partial \mathcal{L}}{\partial \lambda_H} = I(M, t_H, t_F) - \delta H \quad \text{(A.5)}$$

$$\frac{\partial W}{\partial t} = \frac{\partial \mathcal{L}}{\partial \lambda_W} = rW + \omega(H, E_\omega)t_\omega - pM - q_Z X_Z - q_F C_F \quad \text{(A.6)}$$

$$\frac{\partial \lambda_H}{\partial t} = -\frac{\partial \mathcal{L}}{\partial H} = -e^{-\beta t}\frac{\partial u}{\partial H} + \lambda_H \delta - \lambda_W t_\omega \frac{\partial \omega}{\partial H} + \mu \frac{\partial t_S}{\partial H} \quad \text{(A.7)}$$

$$\frac{\partial \lambda_W}{\partial t} = -\frac{\partial \mathcal{L}}{\partial W} = -\lambda_W r \quad \text{(A.8)}$$

(A.2) can be rewritten as

$$\lambda_H = \lambda_W \frac{p}{\partial I/\partial M} = \lambda_W \pi_M \quad \text{(A.9)}$$

where π_m is the efficient price of care. If we derive (A.9) with respect to time

$$\frac{\partial \lambda_H}{\partial t} = \frac{\partial \lambda_W}{\partial t}\pi_M + \lambda_W \frac{\partial \pi_m}{\partial t} \quad \text{(A.10)}$$

From equation (A.4) we get

$$\lambda_H = \lambda_W \pi_F - \frac{e^{-\beta t}}{\partial I_H/\partial X_F}\frac{\partial u}{\partial C_F}\frac{\partial C_F}{\partial X_F} \quad \text{(A.11)}$$

where π_F is the efficient price of friends' time.

If we equate conditions (A.9) and (A.11) we get

$$\lambda_W = -\frac{e^{-\beta t}}{\partial I_H/\partial X_F}\frac{\partial u}{\partial C_F}\frac{\partial C_F}{\partial X_F}\frac{1}{\pi_M - \pi_F} \quad \text{(A.12)}$$

making use of (A.12) in (A.7) we get

$$\frac{\partial \lambda_H}{\partial t} = \lambda_H \delta + t_\omega \frac{\partial \omega}{\partial H}\frac{e^{-\beta t}}{\partial I_H/\partial X_F}\frac{\partial u}{\partial C_F}\frac{\partial C_F}{\partial X_F}\frac{1}{\pi_{t,M} - \pi_{t,F}} + \mu \frac{\partial t_s}{\partial H} - e^{-\beta t}\frac{\partial u}{\partial H} \quad \text{(A.13)}$$

which is equation (9).

In order to get equation (8) we make use of equations (A.8), (A.9) and (A.10) in equation (A.7) so to get

$$\frac{\partial u_t}{\partial H_t}\left(\frac{e^{-\beta t}}{\lambda_{t,W}}\right) + t_{t,\omega}\frac{\partial \omega_t}{\partial H_t} + \frac{\mu_t}{\lambda_{t,W}}\left(\frac{\partial t_{t,S}}{\partial H_t}\right) = \pi_t\left[\delta_t + r - \frac{\partial \pi_t}{\partial t}\frac{1}{\pi_t}\right] \tag{A.14}$$

References

Bassett, E. and S. Moore (2013). Social capital and depressive symptoms: the association of psychosocial and network dimensions of social capital with depressive symptoms in montreal, canada. *Social Science & Medicine 86*, 96–102.

Burton, N. W. and G. Turrell (2000). Occupation, hours worked, and leisure-time physical activity. *Preventive medicine 31*(6), 673–681.

Cacioppo, J. T., L. C. Hawkley, L. E. Crawford, J. M. Ernst, M. H. Burleson, R. B. Kowalewski, W. B. Malarkey, E. Van Cauter, and G. G. Berntson (2002). Loneliness and health: Potential mechanisms. *Psychosomatic Medicine 64*(3), 407–417.

Campbell, I. (2002). Extended working hours in australia. *Labour & Industry: a journal of the social and economic relations of work 13*(1), 91–110.

Chiang, A. (1992). Elements of dynamic optimization. mcgaw-hill. *New York*.

Cohen, S. (2004). Social relationships and health. *American psychologist 59*(8), 676.

Contoyannis, P. and A. M. Jones (2004). Socio-economic status, health and lifestyle. *Journal of health economics 23*(5), 965–995.

Giordano, G. N. and M. Lindström (2011). Social capital and change in psychological health over time. *Social science & medicine 72*(8), 1219–1227.

Gump, B. B. and K. A. Matthews (2000). Are vacations good for your health? the 9-year mortality experience after the multiple risk factor intervention trial. *Psychosomatic Medicine 62*(5), 608–612.

House, J. S. (2001). Social isolation kills, but how and why? *Psychosomatic Medicine 63*(2), 273–274.

House, J. S., K. R. Landis, D. Umberson, et al. (1988). Social relationships and health. *Science 241*(4865), 540–545.

Kenkel, D. S. (1995). Should you eat breakfast? estimates from health production functions. *Health Economics 4*(1), 15–29.

Kouvonen, A., M. Kivimäki, M. Elovainio, M. Virtanen, A. Linna, and J. Vahtera (2005). Job strain and leisure-time physical activity in female and male public sector employees. *Preventive Medicine 41*(2), 532–539.

Likert, R. (1952). A technique for the development of attitude scales. *Educational and psychological measurement 12*(2), 313–315.

Lindström, M. (2004). Social capital, the miniaturisation of community and self-reported global and psychological health. *Social science & medicine 59*(3), 595–607.

Lindström, M. and G. N. Giordano (2016). The 2008 financial crisis: Changes in social capital and its association with psychological wellbeing in the united kingdom–a panel study. *Social Science & Medicine 153*, 71–80.

McCulloch, A. (2001). Social environments and health: cross sectional national survey. *Bmj 323*(7306), 208–209.

McPherson, M., L. Smith-Lovin, and M. E. Brashears (2008). Social isolation in america: Changes in core discussion networks over two decades. *American Sociological Review 73*(6), 1022–1022.

Pressman, S. D., K. A. Matthews, S. Cohen, L. M. Martire, M. Scheier, A. Baum, and R. Schulz (2009). Association of enjoyable leisure activities with psychological and physical well-being. *Psychosomatic Medicine 71*(7), 725–732.

Putnam, R. D. (1995). Bowling alone: America's declining social capital. *Journal of democracy 6*(1), 65–78.

Putnam, R. D. (2001). *Bowling alone: The collapse and revival of American community*. Simon and Schuster.

Robone, S., A. M. Jones, N. Rice, et al. (2008). Contractual conditions, working conditions, health and well-being in the british household panel survey. *Health, Econometrics and Data Group Working Paper 8*, 19.

Ryff, C. D., B. H. Singer, and G. D. Love (2004). Positive health: Connecting well-being with biology. *Philosophical Transactions-Royal Society of London Series B Biological Sciences*, 1383–1394.

Sickles, R. C. and A. Yazbeck (1998). On the dynamics of demand for leisure and the production of health. *Journal of Business & Economic Statistics 16*(2), 187–197.

Tominaga, K., J. Andow, Y. Koyama, S. Numao, E. Kurokawa, M. Ojima, and M. Nagai (1998). Family environment, hobbies and habits as psychosocial predictors of survival for surgically treated patients with breast cancer. *Japanese journal of clinical oncology 28*(1), 36–41.

Uchino, B. N. (2006). Social support and health: a review of physiological processes potentially underlying links to disease outcomes. *Journal of behavioral medicine 29*(4), 377–387.

Umberson, D. and J. K. Montez (2010). Social relationships and health a flashpoint for health policy. *Journal of Health and Social Behavior 51*(1 suppl), S54–S66.

Table 1: Summary statistics

	(1) All mean	(2) Men mean	(3) Women mean	(4) Non-manual job mean	(5) Manual job mean
Reporting Poor Fair Health	0.29	0.27	0.31	0.22	0.37
Psychological well-being	11.20	10.49	11.82	10.84	11.55
Age	39.90	39.84	39.95	38.23	41.49
Married	0.57	0.58	0.57	0.59	0.56
Weekly hours worked	21.26	25.15	17.92	29.60	13.34
Weekly overtime	2.38	3.29	1.60	3.12	1.68
Active in any org.	0.47	0.49	0.44	0.51	0.42
Active in sports club	0.19	0.26	0.14	0.23	0.15
N. of org. active in	0.69	0.71	0.66	0.78	0.59
Observations	103228	47733	55495	50295	52933

Table 2: Fixed Effects model for Social Participation: Self-rated physical and psychological well-being

	Poor/Fair health			Psychological well-being		
	(1) All	(2) All	(3) All	(4) All	(5) All	(6) All
Active in any org.	-0.0292***			-0.423***		
	(0.000722)			(0.0182)		
Active in sports club		-0.0412***			-0.516***	
		(0.00340)			(0.0152)	
N. of org. active in			-0.0280***			-0.400***
			(0.00196)			(0.0331)
N. of org. active in (sq.)			0.00433***			0.0722***
			(0.000996)			(0.00731)
Observations	102051	102051	102051	102051	102051	102051
R^2	0.316	0.316	0.316	0.123	0.123	0.123
Ind. FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Fixed Effects model for Social Participation: Self-rated physical and psychological well-being, Men

	Poor/Fair health			Psychological well-being		
	(1) All	(2) All	(3) All	(4) All	(5) All	(6) All
Active in any org.	-0.0376***			-0.363***		
	(0.00117)			(0.0155)		
Active in sports club		-0.0491***			-0.419***	
		(0.00354)			(0.0362)	
N. of org. active in			-0.0390***			-0.336***
			(0.00380)			(0.0285)
N. of org. active in (sq.)			0.00694**			0.0612***
			(0.00195)			(0.00804)
Dem.	Yes	Yes	Yes	Yes	Yes	Yes
Education	Yes	Yes	Yes	Yes	Yes	Yes
Observations	47201	47201	47201	47201	47201	47201
R^2	0.305	0.306	0.306	0.113	0.113	0.113
Ind. FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Fixed Effects model for Social Participation: Self-rated physical and psychological well-being, Women

	Poor/Fair health			Psychological well-being		
	(1) All	(2) All	(3) All	(4) All	(5) All	(6) All
Active in any org.	-0.0254***			-0.438***		
	(0.00111)			(0.0246)		
Active in sports club		-0.0464***			-0.491***	
		(0.00231)			(0.0471)	
N. of org. active in			-0.0228***			-0.421***
			(0.00276)			(0.0318)
N. of org. active in (sq.)			0.00333**			0.0734***
			(0.000898)			(0.00738)
Dem.	Yes	Yes	Yes	Yes	Yes	Yes
Education	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54850	54850	54850	54850	54850	54850
R^2	0.326	0.326	0.326	0.115	0.114	0.115
Ind. FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Fixed Effects model for Social Participation: Self-rated physical and psychological well-being, non-manual jobs

	Poor/Fair health			Psychological well-being		
	(1) All	(2) All	(3) All	(4) All	(5) All	(6) All
Active in any org.	-0.0208***			-0.302***		
	(0.00103)			(0.0385)		
Active in sports club		-0.0377***			-0.468***	
		(0.00312)			(0.0106)	
N. of org. active in			-0.0240***			-0.260**
			(0.00265)			(0.0609)
N. of org. active in (sq.)			0.00354*			0.0510**
			(0.00138)			(0.0139)
Dem.	Yes	Yes	Yes	Yes	Yes	Yes
Education	Yes	Yes	Yes	Yes	Yes	Yes
Observations	49763	49763	49763	49763	49763	49763
R^2	0.226	0.227	0.191	0.063	0.063	0.062
Ind. FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Fixed Effects model for Social Participation: Self-rated physical and psychological well-being, manual jobs

	Poor/Fair health			Psychological well-being		
	(1) All	(2) All	(3) All	(4) All	(5) All	(6) All
Active in any org.	-0.0378***			-0.543***		
	(0.00161)			(0.0144)		
Active in sports club		-0.0462***			-0.578***	
		(0.00372)			(0.0299)	
N. of org. active in			-0.0348***			-0.525***
			(0.00180)			(0.0194)
N. of org. active in (sq.)			0.00438***			0.0806***
			(0.000534)			(0.00445)
Dem.	Yes	Yes	Yes	Yes	Yes	Yes
Education	Yes	Yes	Yes	Yes	Yes	Yes
Observations	52288	52288	52288	52288	52288	52288
R^2	0.347	0.347	0.348	0.165	0.164	0.165
Ind. FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$