Putting different price tags on the same health condition: Re-evaluating the well-being valuation approach

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Abstract

Many recent writings in health policy have proposed that health be valued directly and in monetary terms using the new well-being valuation method. Yet there is no clear consensus on what the best measure of individual's experience may be for the evaluation process. To shed light on this issue, monetary values for a number of health problems are compared across different well-being measures within the same UK data set. We find that, while there is strong internal consistency of health impacts within each well-being measure, hugely different monetary valuations are obtained for the same health problem across different well-being measures. Our results, although should only viewed as illustrative, call for economists to rethink about which measure of well-being or experienced utility to be used in the well-being valuation method, should the approach ever be implemented in real policy contexts.

Keywords: Well-being; compensation variations; monetary valuations; happiness; health; GHQ

JEL codes: H8; I18; I31

1. Introduction

Many recent writings in health policy have proposed that health be valued directly and in monetary terms using the well-being valuation (WV) method. Yet there is no clear consensus within the literature on what the best measure of individual's experience may be for the evaluation process.

Our paper explores whether different measures of well-being produce similar monetary values of the same health condition. We present econometric evidence that the monetary values of the same health condition vary substantially across different well-being measures within the given data set. Our results suggest that economists may need to consider these differences in the monetary values of the same health condition before the well-being valuation method can be taken seriously in health, as well as in public policy.

More specifically, this paper documents evidence that:

(i) There is considerable internal consistency in the ordinal ranking of health conditions across different well-being measures, with depression often ranking first in terms of impact;

(ii) Measures of overall well-being such as life satisfaction generate significantly smaller values of health compensation for the same health condition than measures of affective well-being such as an individual's recent states of mental well-being, and measures of domain-specific well-being such as health satisfaction and self-assessed health compared to other people of the same age.

2. Background

Within the medical profession, the process of assigning monetary values to different health conditions is viewed as controversial and unethical in determining health care resource allocations. The idea that health conditions should be evaluated and ranked in terms of how much people are willing to pay in order to avoid them, or willing to pay for treatments to cure them, seems to contradict with what the central objective of health care

systems aim to achieve which is to grant all citizens access to health care irrespective of their ability to pay (Cutler, 2002; Smith & Richardson, 2005). It also weighs heavily against the common (health care) perception that every human life should have equal values (Johansson-Stenman & Martinsson, 2008). Such concerns are reflected in the UK's National Institute for Health and Clinical Excellence's (NICE) recommendations that health benefits are to be measured in terms of gains in quality adjusted life years (QALYs) rather than basing them on people's willingness to pay (see, e.g., Rawlins & Culyer, 2004).

Despite the controversy surrounding the methods used to attach monetary values to different health conditions, there appears to be an increasing tendency within the academic community to try and encourage health policy makers to value health directly in monetary terms (e.g., Diener et al., 1998; Klose, 1999; Ferrer-i-Carbonell & Van Praag, 2002; Gyrd-Hansen, 2003; Mentzakis, 2011). One of the main reasons for this is that monetary values of health enable *direct* comparisons between the relative benefits and costs of different treatments or interventions, thus making decisions about which conditions and treatments to prioritise more straightforward for policy makers compared with, for instance, cost-effectiveness analysis (Johannesson, 1995) or multiple criteria analysis (Devlin & Sussex, 2011)..

There is apparently no clear consensus on what the best method of evaluation may be. At present, one of the most used approaches by economists is the revealed preference (RP) approach. Here, people's revealed preferences or behaviours in the market are used to derive values for different health conditions, e.g., by analysing health risks people are willing to take in exchange for higher wages.[2] Despite its appeals – one being a clear objective indicator of individual's health preferences – there are a number of empirical limitations to this RP approach. For instance, the RP method does not easily allow for generalisation across different cases of health conditions, and representative data can sometimes be very difficult to collect.

[2] For comprehensive overviews of the RP method, see Viscusi (1993), Viscusi & Aidy (2003), and Viscusi (2010).

As a solution, the contingent valuation (CV) method, which is a survey-based hypothetical and direct method to elicit monetary valuations of effects of health technologies and conditions (see, e.g., O'Brien & Gafni, 1996 or Tsuchiya & Williams, 2001), had been adopted by economists as an alternative to the RP method.[3] By asking individuals to directly state their willingness to pay for medicines or treatments of an illness, or for inclusion of medicines or treatments in health insurance package, or on reimbursement list in case of a national health system, the CV approach allows for easy generalisation across different health conditions of interest, while it is also relatively inexpensive to collect CV data on a large scale (Donaldson et al., 1995; Liu et al., 2000; Amin & Khondoker, 2004; Pinto-Prades et al., 2009; Van der Star & Van den Berg, 2010).

It is, however, well-known that the CV method is not without serious biases. First there is a substantial disparity between willingness to pay (WTP) and willingness to accept values in empirical studies (WTA). For example, it has been found that the WTA/WTP ratios vary from 2.5 to 2.9 (Brown, 2005). Although a smaller difference has been reported in a health care application (Van den Berg et al., 2005), this disparity puts a serious question mark on the validity of CV responses, given that such a difference cannot be explained by income effects alone (Hanemann, 1991). This disparity suggests that the CV method suffers from several cognitive biases such as loss aversion, the endowment effect, and the focusing effect (see Kahneman & Tversky, 1979; Kartman et al., 1998). For example, one of the explanations for WTP exceeding WTA for similar goods is the endowment effect. The endowment effect is people's tendency to value something more once ownership has already been established – simply because they tend to believe that the utility of a loss is greater than the utility of an equivalent gain (Kahneman et al., 1990). Translated to the health framework, the compensation required for a health loss (WTA) tends to exceed the amount a person would be willing to pay for the equivalent health gain (O'Brien et al., 2002).

[3] For overviews of applications of the CV method in health care, see Diener et al. (1999); Klose (1999); & Smith (2003).

More recently, a new approach – the WV method – has been proposed within the economics literature as an alternative for and complement to the RP and the CV methods. The method can be used to determine monetary values of health conditions. It involves taking a randomly-selected representative sample of individuals and asks them to self-rate their experiences such as life satisfaction or moment-to-moment happiness levels. Then it uses regression techniques to work out the implied 'shadow price' of different types of health problems, i.e. the additional income (on top of the household income) needed to be given to the individual to just compensate – no more, no less – for the well-being losses from acquiring a particular health condition. To put it in simpler terms, the WV approach allows the importance of different health losses to be studied empirically (ex post) rather than hypothetically (ex ante) by regressing a measure of well-being on different health conditions controlled for other personal characteristics. When income is also included in the regression and provided that the estimated coefficient on income enters positively and statistically significantly in the well-being equation, it is then possible to approximate trade-offs between income and each of the health conditions by estimating the increase in income that is required to offset a given health loss in the well-being measure.

There is a growing acceptance of the WV method in the economics literature. It has been used, for example, to calculate monetary valuations for many of the occurrences in life that have no obvious market values. This includes the values of marriage (Blanchflower & Oswald, 2004), the extent of social network (Powdthavee, 2008) and air quality (Luechinger, 2009), as well as the costs of marital separation (Clark & Oswald, 2002), crime (Powdthavee, 2005; Moore & Shepherd, 2006), a natural disaster (Luechinger & Raschky, 2009), bereavements (Oswald & Powdthavee, 2008), informal care (Van den Berg & Ferrer-i-Carbonell, 2007), terrorism (Frey et al., 2009), and airport noise (Van Praag & Baarsma, 2005). With respect to health, two of the first economists to use the WV method to value different types of chronic conditions were Ferrer-i-Carbonell & Van Praag (2002). They estimated how much *additional* income is needed to compensate for the loss of well-being brought about by health conditions including diabetes, blood

pressure problem, and migraine.[4] For more recent attempts, see Groot & Van den Brink (2004, 2006).

The main difference between the WV and the CV methods is that 'utility' is conceptualized differently between the two approaches.[5] While the CV approach attempts to elicit people's WTP through their stated preferences and based on their expected utility over different hypothetical situations, the WV approach argues that what really defines the impact of a health problem is not the expected utility. Rather, it is defined by the way people experience that particular condition in their lives (Kahneman et al., 1997; Dolan & Kahneman, 2008; Dolan et al., 2009). Therefore, a more direct measure of people's experiences that does not explicitly draw people's attention too much towards the impact of health condition in question is required to value the impact of health conditions in monetary terms.[6]

While the debate on whether or not health should be valued by means of experienced utility is starting to take off in political discussions, one important question remains: Which measure of well-being should we use to assess the monetary values of health conditions? Currently, there are many measures of subjective experience used as 'proxy' for utility in the economics literature. Yet there is no general consensus on the gold standard measure of experience, one which health practitioners can and should adopt when it comes to evaluating health in monetary terms. For example, while the most used measure of experienced utility in the WV approach is the life satisfaction scale (Blanchflower & Oswald, 2004; Van Praag & Baarsma, 2005; Van den Berg & Ferrer-i-Carbonell, 2007; Powdthavee, 2008), scholars have also used other measures of well-

[4] See Mentzakis (2010) for more recent estimates for the United Kingdom. The other paper that systematically examined the relationships between satisfaction levels and health problems for the United Kingdom is a paper by Groot (2000). Groot (2000) did not derive monetary values of health but derived QALY values for various chronic conditions.

[5] Van den Berg & Ferrer-i-Carbonell (2007) compared the WV method with the CV method and suggested that both methods yield similar results. However, their application of the CV method involved only marginal changes from the life experience under question (providing an extra hour of informal care) and it is therefore still an empirical question whether or not both methods will produce similar when valuing non-marginal changes and in other applications like the valuation of health.

[6] For a more detailed theoretical discussion of the WV method, see Kahneman et al. (1997), Kahneman & Sugden (2005), and Dolan & Kahneman (2008).

being such as the General Health Questionnaire (GHQ-12) and health satisfaction (see, e.g., Ferrer-i-Carbonell & Van Praag, 2002; Clark & Oswald, 2002; Oswald & Powdthavee, 2008). Others even used measures of attitudes towards the experience in question, i.e. fear of crime (Moore & Shepherd, 2006). Could these different measures generate consistent monetary values for the same health conditions? Our hypothesis is that it is unlikely that the monetary valuations of health conditions will be consistent across all well-being measures for at least two reasons: (1) both valuation questions intend to measure at least partly different concepts, and (2) income has been found to correlate more with measures of cognitive well-being – such as life satisfaction – than measures of affects or moods – such as the GHQ-12 (see, e.g., Kahneman et al., 2006). In addition, Huppert and Whittington (2003) found that health and income may affect ill-being and well-being differently, considering that ill-being and well-being are two distinct dimensions and not opposite ends of the same scale. Therefore, a natural empirical question is: To what extent do different experience measures produce different monetary valuations of the same health condition. To the best of our knowledge, no study has directly compared the monetary valuations of health between different measures of experiences.

This paper aims to contribute to the WV literature by examining the internal and external consistencies of various health impacts on different measures of experienced utility within the same dataset. We study the numbers that people report when asked about a) how satisfied they are with their life overall, b) their usual states of mental well-being, c) their health satisfaction, and d) their self-assessed health compared to other people of their age. The four measures were selected primarily because they all had been studied extensively in either the well-being or the health policy literature.

Using a British panel data set, we estimate micro-econometric experience measure equations with various health conditions and disabilities as explanatory variables. We attempt to derive monetary values of the health conditions and disabilities by calculating how much extra income would be required to compensate for each condition in each well-being equation.

3. Data

The data set comes from the British Household Panel Survey (BHPS). This is a nationally-representative sample of British households, containing over 10,000 adult individuals. The survey has been conducted between September and Christmas of each year from 1991 (Taylor et al., 2002).

This paper draws on two survey questions on self-reported health problems in the BHPS. The first set of questions asks each individual in every wave of the BHPS to state which (but not limited to one) of the following thirteen health conditions (problems, illnesses or disabilities) he or she has, excluding temporary conditions:

1. Problems with arms, legs, and hands
2. Difficulty seeing
3. Difficulty hearing
4. Skin conditions/allergies
5. Chest/breathing problems
6. Problems with heart and blood pressure
7. Problems with stomach/kidney/liver
8. Diabetes
9. Nerves/anxiety/depression
10. Alcohol/drugs
11. Epilepsy
12. Migraine/chronic headache
13. Other

Although self-reported, the checklist of these health conditions has been shown to correlate well with GP reports (Kriegsman et al., 1996) and the use of health and welfare services (Sacker et al., 2003). People seem more likely to under-report their true health conditions in the absence of a list. There is also evidence that the inclusion of a checklist

of conditions in the survey encourages reporting of illnesses by the genuinely ill and not by those who are less severely affected by their disease (Knight et al., 2001).

The second set of questions asks individuals about their physical functioning: "Does your health in any way limit (a) your daily activities and (b) amount or type of work compared to most people your age?"

In terms of well-being, we use four measures of experience which were previously used or discussed in the well-being valuation literature: (a) overall life satisfaction, (b) the usual states of mental well-being, (c) health satisfaction, and (d) self-assessed health. The questions of the first three measures appear in the self-completion section of the questionnaire, whereas the question on self-assessed health is asked face-to-face by an interviewer. The order of appearance is that self-assessed health is asked first as part of the face-to-face interview, then the usual states of mental well-being, followed by health satisfaction, and finally overall life satisfaction. Apart from the health satisfaction and the life satisfaction questions which are placed close to each other, the others are allocated much further apart, with different types of other questions slotted in between.

Responses to the life satisfaction question are elicited using the following question: *"All things considered, how satisfied or dissatisfied are you with your life overall using a 1-7 scale? 1 = very dissatisfied, …, 7 = very satisfied"*. By definition, life satisfaction is constructed with an aim to elicit the respondent's past, present, and future global well-being (Diener et al., 1985). It has been shown in the literature to represent a measure of cognitive well-being as opposed to affect

The mental well-being score is derived from the General Health Questionnaire (GHQ-12) score. The scale is considered by many medical scholars and other researchers as a good proxy for mental stress and strain (see, e.g., Guthrie et al., 1998). Recent applications of GHQ include Clark & Oswald (2002), Pevalin & Ermisch (2004), Robinson et al. (2004), Oswald & Powdthavee (2007), and Powdthavee & Vignoles (2008). Individuals indicate on a 4-point scale from 1 (*no more than usual*) to 4 (*much more than usual*) how often

over the past few weeks they had lost sleep over worry, felt constantly under strain, felt they could not overcome difficulties, been feeling unhappy and depressed, been losing confidence, and been feeling like a worthless person. Individuals were also asked to indicate on a 4-point scale from 1 (*better than usual*) to 4 (*much less than usual*) on how often over the past few weeks that had felt that they were playing a useful part in things, felt capable of making decisions, been able to enjoy day-to-day activities, been able to concentrate, been able to face up to problems, and been feeling reasonably happy. We use the Likert score of GHQ, which is the summation of all the responses to the GHQ questions. This is the BHPS variable HLGHQ1, with a scale running from 0 (best mental well-being) to 36 (worst mental well-being). However, for simplicity, we have decided to reverse the original HLGHQ1 coding so that the value of 0 represents the worst mental well-being and 36 is the best mental well-being. Measures such as GHQ-12 are therefore considered to be a shorter-term measure of well-being, i.e. affects, compared to life satisfaction.

The health satisfaction question has the following wordings: *"How satisfied or dissatisfied are you with your health overall using a 1-7 scale? 1 = very dissatisfied, ..., 7 = very satisfied"*.

Finally, self-assessed health is one of the most often used survey question to measure health (see, e.g., Contoyannis et al, 2004, or Powdthavee, 2009). Exact wording in the BHPS is: *"Please think back over the last 12 months about how your health has been. Compared to people of your own age, would you say that your health has on the whole been excellent, good, fair, poor, very poor?"* The responses are coded so that 1 = very poor health, ..., 5 = excellent health.

This study uses data from Waves 6-18 in the BHPS. However, we had to omit Waves 9, 11 and 14 from the analysis as they either do not contain a set of questions on health and life satisfactions, or the self-assessed health question was asked differently – i.e., not comparing against other peers of the same age group – in these surveys. We restrict the sample to contain those of working age (16-65) with information on health conditions

and the four measures of life experience. This yields an unbalanced panel of 104,537 observations (22,169 unique individuals). Of those, roughly 29% reported to have at least one listed health problem, and approximately 25% reported to have two or more. Around 14% said that their health has limited them from doing day-to-day activities, and 15% said that their health has limited the amount or type of work that they could do. Correlations among the four measures of life experience are moderate ranging from 0.35 to 0.66. The smallest correlation coefficient (=0.35) indicates the correlation between self-assessed health and life satisfaction, whilst the largest correlation coefficient (=0.66) reflects the correlation between self-assessed health and satisfaction with health. A detailed summary of descriptive statistics is reported in Table 1.

4. Empirical strategy

Assume, as in Blanchflower & Oswald (2004), that there exists a generalized well-being function:

$$W = u(h, y, z) + e, \qquad (1)$$

where W denotes individual's well-being; the $u(.)$ function is the respondent's life experience or well-being and is observable only to the individual asked; h represents health stock; y denotes income; z is a set of socio-demographic and personal characteristics; and e is an error term that subsumes the inability of human beings to communicate accurately their levels of life experience. The well-being $u(...)$ is assumed to be increasing in both h and y.

The monetary valuation of having a health condition on life experience or well-being can be determined by estimating the following empirical counterpart to equation (1)

$$W_{it} = H_{it}^{'}\beta + \gamma Y_{it} + X_{it}^{'}\lambda + \varepsilon_{it}, \quad i = 1...N, t = 1...T, \qquad (2)$$

where W_{it} is the well-being score, i.e., 1-7 on the life satisfaction and the satisfaction with health scales, 0-36 on the mental well-being or the inverse-GHQ scale, or 1-5 on the self assessed health scale; $H_{it}^{'}$ contains a vector of health condition and problem dummies; Y_{it} is log of real equivalent household income (which is defined as the log of real household income/square of the number of people in the household); and $X_{it}^{'}$ are other standard controls in experience or well-being equations, including dummies for gender, age, age-squared, marital status, education dummies, employment dummies, number of dependent children, region and year (see, e.g., Blanchflower & Oswald, 2004). In order to account for individual unobserved components, we also introduce individual random effects into the equation. Hence, the error term can be decomposed to the individual random effect component, η_i, and the time-varying component, υ_{it}, as follows:

$$\varepsilon_{it} = \eta_i + \upsilon_{it}. \tag{3}$$

Following Ferrer-i-Carbonell & Van Praag (2004), we decompose the explanatory variables of interest – in this case, health problems and income – into their mean over the observation period and the deviation from that mean as follows:

$$H_{it}^{'} = \overline{H}_i^{'} + (H_{it}^{'} - \overline{H}_i^{'}), \tag{4}$$

$$Y_{it} = \overline{Y}_i + (Y_{it} - \overline{Y}_i), \tag{5}$$

Introduction of the mean variables helps to correct for the unobserved correlation between the individual random effects and the explanatory variables of interest (see Mundlak, 1978). We can also interpret the addition of the mean variables as a way to decompose both health and income into a *level* and a *shock* effect. Equation (2) becomes

$$W_{it} = H_{it}^{'}\beta + \overline{H}_{it}^{'}\theta + \gamma Y_{it} + \delta\overline{Y}_{it} + X_{it}^{'}\lambda + \varepsilon_{it}. \tag{6}$$

Here, the relevant income effects are given by:

$$\gamma Y_{it} + \delta \overline{Y}_i = \gamma(Y_{it} + \overline{Y}_i) + (\gamma + \delta)\overline{Y}_i . \quad (7)$$

The coefficient γ is the shock effect and $(\gamma + \delta)$ is the level effect (or the combined effect of current and permanent incomes). As in Ferrer-i-Carbonell & Van Praag (2002), we will use the level effect of income – which is taken to be the individual's permanent income – to calculate the monetary valuations or the implied shadow price of the level effect of each health condition, i.e. $\beta + \theta$. This implied shadow price, by definition, is equivalent to the extra income required to keep the person with a particular health condition at the same level of well-being as if he or she is free from that particular health problem. More formally,

$$(\gamma + \delta)\ln(SP + y) + (\beta^{blood} + \theta^{blood}) = (\gamma + \delta)\ln(y),$$

$$\ln(SP + y) = \ln y \times \frac{-(\beta^{blood} + \theta^{blood})}{\gamma + \delta},$$

$$SP = y \times (\exp \frac{-(\beta^{blood} + \theta^{blood})}{\gamma + \delta} - 1), \quad (8)$$

where *SP* is the calculated shadow price (or how much extra money is required to compensate an average person with a blood pressure problem), and *y* is the average level of real equivalent household income. Thus, an individual with a blood pressure problem, i.e. $H_{it}^{blood} = 1$, and an income of *y* + *SP* will have the same level of well-being as an individual with no blood pressure problem and an income of *y*. The unit of these valuations is in pound sterling (£).

This regression method assumes cardinality for all measures of experienced utility. Although cardinality is a much stronger assumption than ordinalty, Frey & Stutzer (2000), Frijters & Ferrer-i-Carbonell (2004), Luttmer (2005), and Powdthavee (2009), suggest that it makes virtually no difference to the trade-offs between estimated coefficients and to the statistical significance of the final outcomes whether one assumes

ordinality or cardinality in the experienced well-being data. Therefore, and for ease of interpretation, we adopt the same method as the previous studies aforementioned and estimate the models using only generalized least squares with random effects.[7]

5. Results

Table 2 reports the life satisfaction, mental well-being, health satisfaction, and self assessed health equations random effects estimates. As would be expected, the health problems enter each well-being equation in a negative manner. In terms of statistical significance, the models seem to produce qualitatively similar results. With respect to health shocks, only 'epilepsy' is not statistically significant in life satisfaction or in mental health, but statistically significant in health satisfaction and self assessed health.

However, it is not straightforward to compare the magnitudes of the coefficients across equations, because of the differences in scales across the four well-being measures. Nevertheless, it is still possible to work out the internal rankings of the *level* effects of health problems and conditions ($\beta + \theta$) and compare them across well-being measures – i.e. comparing the ordinal ranking of the size of the estimated dummy coefficients of health problems and conditions *within* each well-being regression equation. Table 3 gives the sum of the parameters required to calculate the shadow price of each health condition, i.e., equation (8) and Table 4 presents the internal rankings of these health problems for each well-being measure which are derived in Panel A of Table 3.

Perhaps expectedly, 'depression and anxiety' ranks very highly in all of the well-being equations, coming up first in two of the four well-being measures. This might support the thinking of a group of British researchers and policy-makers who have argued that the advanced societies should allocate substantially more resources to the treatment of depression (see, e.g., Bell et al. 2006; Dolan & Layard, 2011). On the contrary, whilst there is a sizeable correlation between 'alcohol or drug related problems' and both life

[7] We are aware that a linear model may lead to an overestimation of the overall average *SP* values of the health problems and a generalized ordered probit model may be preferred to the more standard approaches adopted here (Mentzakis, 2010).

satisfaction and mental well-being, the same health problem only ranks eleventh and eight in the health satisfaction and self assessed health equations. This implies that some health problems correlate more with overall well-being than with subjective health status. It is also worth noting that 'other health problems not listed' also ranks relatively high in all models, although we do not know what constitute these other health problems, i.e. we do not know whether they are mental or physical by nature.

Despite some notable differences, we find the correlations between how health impacts are ranked internally to be positive and sizeable across the different well-being measures. For example, the lowest correlation coefficient is between mental well-being and self-assessed health (=0.632), whilst the highest correlation coefficient is between health satisfaction and self-assessed health (=0.979). The correlation coefficient between life satisfaction and mental well-being is approximately 0.8 (see the bottom of Table 4). This relatively stable internal ranking represents an important finding for health policy in that the various measures of life experience could all be used to derive a consistent ranking of the impacts of health conditions on people's quality of life. This is primarily because the ability to produce a valid ordinal ranking of health problems could prove useful when it comes to making reimbursement decisions or compare performances in health policy.

Whilst consistency in the internal rankings across different well-being measures provides some comforts for the advocates of the WV approach, it is thought that the estimated monetary values of health will be even more appealing to policy makers as they would enable straightforward comparisons between costs and potential benefits of investments in health care. Table 5 presents the calculated monetary values of health problems and conditions according to equation (8).

To many, the in Table 5 reported *SP* values may be hard to grasp, as well as difficult to imagine them to be ever formally implemented in real life decision-making[8]. For

[8] It appears that most SPs – which are measured per year – tend to exceed an individual's annual income. One reason for this is that the SPs are the estimated 'income equivalent' of the loss of well-being brought about by a health condition. Given that, on average, health matters significantly more to our subjective well-being than do incomes (see, e.g., Powdthavee, 2008), it should then be no surprising to us why SPs are

example, in order to compensate an average individual with a health problem connected with 'arms, legs, hand, feet, back, etc.', to bring her back at the same level of self-assessed health (SAH) as someone who does not have this health problem, an additional pay of £1,657,000 per anum (pa) is required. However, in order to compensate the same average person for the same health problem so that she reports the same level of life satisfaction as someone who does not possess this health condition, only £7,000 pa is considered a sufficient compensation package. Only a few health problems share similar *SP* values, e.g. £5,000 pa are needed to compensate an average individual for a drop in life satisfaction and mental well-being from having 'skin conditions/allergies', and £2,000-£6,000 pa are required to restore an average person's life satisfaction and mental well-being from 'diabetes'.[9] Moreover, we could see that the *SP* values are often significantly smaller when they had been produced in the equation where life satisfaction is the dependent variable, and incomprehensively high *SP* values are generally observed in the equation where health satisfaction is the dependent variable, perhaps due to the relatively smaller and less precisely estimated income coefficient in the health satisfaction equations. The differences are made even clearer in Table 5 when we compare the *SP* values across different well-being measures. Of the ten highest *SP*s, nine were obtained from running the health satisfaction equation. By contrast, the bottom ten *SP*s – ranking from 50^{th} to 60^{th} – include seven from the life satisfaction equation, thus confirming that there are significant quantitative differences in terms of the monetary valuation of the same health condition across different well-being measures. Such quantitative differences naturally involve the question: Which well-being measure should policy makers use if the WV approach is to be taken seriously in decision-making?

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often greater than what our annual income could buy us in terms of well-being. Moreover, it is worth noting that the calculated estimates according to the WV method are in contrast with the CV method not bounded by respondent's income.

[9] Our estimates obtained from running life satisfaction equations are generally larger than the ones obtained by Mentzakis (2011). This is partly because income is entered in its natural log form in our study, whereas a linear form of income is assumed in Mentzakis' study. We prefer the log specification as it assumes decreasing marginal utility of income (see, e.g., also Ferrer-i-Carbonell & Van Praag, 2002). Moreover, studies on the curvature of income in happiness equations have shown that happiness is better explained by log income than by its level (see, e.g., Layard et al., 2008). Despite using a log specification of income, as did Ferrer-i-Carbonell & Van Praag (2002), our estimates appear to be larger than their obtained estimates. As they combined life satisfaction data from Germany with health satisfaction data and data on health conditions from the United Kingdom and the United States, it is not straightforward their results with our results.

An additional question of interest is whether the calculated *SPs* vary significantly across different sub-groups of population. Though not presented here, our sub-sample regressions by gender and age group suggest that there is considerable heterogeneity in the estimated *SP* values across sub-populations. The estimated *SPs* are generally larger for the same health problem *and* well-being measure for women than for men, and for younger cohorts (age $\leq$ 40 years old) than for older cohorts (40>age $\geq$ 65 years old). For instance, approximately £3,000 pa is required to compensate an average male for problems with arms, legs, hand, feet, back, etc. By contrast, the equivalent *SP* for women is £15,000 pa. A potential explanation for such differences is that the marginal utility of income is higher for men than for women and for older cohorts than for younger cohorts. An alternative explanation is that the marginal disutility of health losses is higher for women than for men and for younger cohorts than for older cohorts.

6. Discussions and conclusions

A few questions suggest themselves.

First, what explains why such a significant difference in *SP* of the same health condition exists? One natural explanation for this is that there is considerable heterogeneity in the effects of health problems across different well-being measures. Health conditions that are related to mental health appear to have large influences on (or rather significant correlations with) measures of overall well-being such as life satisfaction and mental well-being, whilst health conditions that are more physical and probably more salient to the health state of the individuals – e.g., 'health limits daily activities', as well as 'amount and type of work' – seem to have produced larger negative coefficients in both health satisfaction and self-assessed health equations. This suggests that when people are asked to evaluate their subjective health status, they tend to focus more on the physical conditions than on their mental state of health. By contrast, problems with mental health are probably built into people's subjective evaluation of the overall quality of life such as life satisfaction and mental well-being. This is consistent with the theory on focusing

effect, which states that people will often exaggerate the impact of any experience on their well-being, particularly if the question prompts them to do so (Schkade & Kahneman, 1998). Given that physical health problems are easily observed and distinctively different to not having them, it is perhaps not surprising that more weights will be given to these conditions in the overall judgments of how healthy we feel compared with how we feel in general about our life. By contrast, money, which is normally less salient compared to other factors in our lives whenever we are asked to think about our overall life satisfaction, will be even less distinct and more likely to be excluded from the subjective assessments of health satisfaction and health compared to other people our age. The same may also apply to the current state of mental well-being when it is compared to how income normally enters life satisfaction equations (Kahneman et al., 2006). In other words, this might explain why the ratios between the size of the income coefficients and that of the health problems may vary a great deal across measures of well-being. For instance, the estimated *SP*s obtained from the life satisfaction equation will tend to be small not because health problems have smaller impacts on the overall judgment of life satisfaction, but simply because of the denominator in equation (8) – i.e. the sum of the two income coefficients – is large. In short, given that *SPs* are income-dependent, it may be the case that the estimated health compensations will be overestimated – and often incomprehensively large – in health satisfaction, self-assessed health, and possibly the mental well-being equations, where the estimated income coefficients are relatively small in size, whilst maybe underestimated in the life satisfaction equation, where the size of the estimated income coefficients are relatively more sizeable. One could also argue that respondents to life satisfaction questions balance income with other aims in life and therefore life satisfaction is a better proxy for experienced utility compared with alternative experience measures.

The second, and more pragmatic, question is: If the WV approach is to be taken seriously by policy makers, which measure of well-being (or experienced utility, as defined by Kahneman et al., 1997) should one use? The results of this article suggest that if the ordinality of health impacts are the main variables of interest for health policy, it does not matter which well-being measure is adopted in the calculation of the ranking of health

impact. Yet if monetary valuations (or the cardinalization) of different health conditions is of policy interest, then it seems feasible and theoretically reasonable to argue for the adoption of life satisfaction as the main well-being measure to be used in the WV approach. This is because, apart from the *SP*s of depression and alcohol/drugs-related problems, the estimated figures for other health problems seem meaningful in practice and therefore feasible in the sense that one could imagine them being allocated to consumers in reality, e.g. £8,000 compensation for having heart/blood pressure problems per year. [10] Even more important, the theory behind life satisfaction is generally assessed by individuals as their 'total' or global well-being which is theoretically and technically sound (Diener et al., 1985), whilst other measures are either domain-specific (e.g., health satisfaction and self-assessed health) or elicit only a short-term affect which may fluctuate much more frequently than life satisfaction (e.g., GHQ-12).

The third question of interest is: are the estimated *SPs* subject to bias because of multicollinearity in the self-reported health conditions? There could, for example, be a potential problem of multicollinearity due to co-morbidity, i.e., older individuals may have reported to have two or more health conditions simultaneously. In addition to this, the correlation between shock and level effects of chronic health problems – e.g., 'diabetes' and 'epilepsy' – is also likely to be high for each individual. To address this problem, we present in the appendix (Tables A1 and A2) (i) the correlation matrix of the thirteen listed health conditions and (ii) the correlation coefficients between the shock and level effects of each health condition. Looking across the columns of Table A1, the highest correlation coefficient is approximately 0.18, which comes from the relationship between 'problems connected with: arms, legs, hand, feet, back, etc.' and 'heart/blood pressure or blood circulation problems'. This implies is that there is unlikely to be a problem of multicollinearity across the different health conditions. However, according to Table A2, it seems that many of the health conditions are highly persistent, i.e., the estimated correlation coefficients are no lower than 0.65. Nonetheless, it is only

[10] Please recall that *SP*s are calculated based on the sample average real equivalent household income of £10,000 per annum. One could extend the calculation of SPs using the average real equivalent household income using the mean income of the average person who has that health condition which might result in slightly different figures.

'diabetes' and 'epilepsy' that have registered a correlation coefficient higher than 0.85, i.e., 0.887 and 0.916, respectively. This seems to suggest that while all *SPs* should be treated with care, these two chronic health conditions should be interpreted even more cautiously compared to the *SPs* of other health problems.

Like all other papers in social sciences, this article is not without limitations. One obvious and major criticism is that both income and health are endogenous in all of the estimated well-being regressions. While we could argue that the influences of the endogeneity bias on well-being estimates are probably the same across all experience measures, we realize that this is very unlikely to be true. Future research should therefore return to instrument for both health and income in each of the tested well-being equations. Moreover, given that the listed health conditions used in this study are self-reported, it is possible that our estimates will be biased from well-known 'ordering' effects, i.e. the estimated health effects may vary according to the order of the survey questions (see, e.g., Stewart et al, 2002; Paloyo, 2009), which implies that the *SPs* presented in this paper should be treated with care.

In conclusion, the relatively stable internal rankings across well-being measures suggests that the various measures of life experience could all be used to derive a consistent ordinal ranking of the impacts of health conditions on people's quality of life – assuming that cardinalization is not of policy concern. This ability to produce a valid ordinal ranking of health conditions is an important policy implication from our results and could prove useful for agencies such as NICE. As soon as a cardinal comparison is necessary, economists often recommend monetary valuation methods.

Although the idea that health conditions could and should be monetarized is often viewed as deeply controversial by clinicians and health policy makers, a recent advancement in the well-being valuation literature has re-opened discussion among health economists about the monetary valuation of different health conditions. There has, however, been relatively little debate about which measure of life experience should preferably be used in the WV approach. This paper was written with an aim to fuel such a debate in mind. It

essentially suggested that we can often obtain different monetary valuations for the same health condition just by changing the dependent variable in the well-being equations. Frequently, the monetary values of the same health condition are not just smaller, but *incredibly* smaller when life satisfaction is used instead of other more affective or domain-specific measures of well-being. Our results suggest that economists and policy makers may need to consider seriously about the distinct differences in the well-being construct before advising on which measure to be used in the WV approach, should it ever be implemented in real policy contexts to put a price tag on different health conditions.

References

Amin, M., Khondoker, F. (2004). A contingent valuation study to estimate the parental willingness-to-pay for childhood diarrhoea and gender bias among rural households in India, *Health Research Policy and Systems*, 2:3.

Bell, S., Clark, D., Knapp, M., Layard, R., Meacher, M., Priebe, S., et al. (2006). The depression report. A new deal for depression and anxiety disorders. London: London School of Economics, The Centre for Economic Performance's Mental Health Group.

Blanchflower, D.G., Oswald, A.J. (2004). Well-being over time in Britain and the USA, *Journal of Public Economics*, 88, 1359-1386.

Brown, T.C. (2005). Loss aversion without the endowment effect, and other explanations for the wta-wtp disparity. *Journal of Economic Behavior & Organization*, 57, 367-379.

Clark, A.E., Oswald, A.J. (2002). A simple statistical method for measuring how life events affect happiness, *International Journal of Epidemiology*, 31, 1139-1144.

Contoyannis, P., Jones, A.M., Rice, N. (2004). The dynamics of health in the British Household Panel Survey, *Journal of Applied Econometrics*, 19, 473-503.

Cutler D.M. (2002). Equality, efficiency, and market fundamentals: the dynamics of international medical-care reform. *Journal of Economic Literature*, 40: 881–906.

Devlin, N.J., Sussex, J. (2011). *Incorporating multiple criteria in HTA: Methods and processes*. London: Office of Health Economics.

Diener, E., Emmons, R.A., Larsen, R.J., Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, 49, 71-75.

Diener, A., O'Brien, B., Gafni, A. (1998). Health care contingent valuation studies: a review and classification of the literature. *Health Economics*, 7, 313-326.

Dolan, P., Kahneman, D. (2008). Interpretations of utility and their implications for the valuation of health. *Economic Journal*, 118, 215-234.

Dolan, P., Lee, H., King, D., Metcalfe, R. (2009). Valuing health directly. *British Medical Journal*, 339, 371-373.

Donaldson, C., Shackley, P., Abdalla, M., Miedzybrodzka, Z. (1995). Willingness to pay for antenatal carrier screening for cystic fibrosis, *Health Economics*, 4, 439-452.

Ferrer-i-Carbonell, A., Van Praag, BMS. (2002). The subjective costs of health losses due to chronic diseases. An alternative model for monetary appraisal. *Health Economics*, 11, 709-722.

Frey, B.S., Luechinger, S., Stutzer, A. (2009). The life satisfaction approach to valuing public goods: the case of terrorism, *Public Choice*, 138, 317-345.

Frey, B.S., Stutzer, A. (2000). Happiness, economy and institutions, *Economic Journal*, 110, 918-938.

Frijters, P., Ferrer-i-Carbonell, A. (2004). How important is methodology for the estimates of the determinants of happiness?, *Economic Journal*, 114, 641-659.

Groot, W. (2000). Adaptation and scale of reference bias in self-assessments of quality of life, *Journal of Health Economics*, 19, 403-420.

Groot, W., Van den Brink, H.M. (2004). A direct method for estimating the compensation variation for severe headache and migraine, *Social Science & Medicine*, 58, 305-314.

Groot, W., Van den Brink, H.M. (2006). The compensating income variation of cardiovascular disease, *Health Economics*, 19, 403-420.

Groot, W., Van den Brink, H.M., Plug, E. (2004). Money for health: the equivalent variation of cardiovascular diseases, *Health Economics*, 13, 859-872.

Guthrie, E., Black, D., Bagalkote, H., Shaw, C., Campbell, M., Creed, F. (1998). Psychological stress and burnout in medical students: a five-year prospective longitudinal study. *Journal of the Royal Society of Medicine*, 91, 237-243.

Gyrd-Hansen, D. (2003). Willingness to pay for a QALY, *Health Economics*, 12, 1049–1060.

Hanemann, W.M. 1991. Willingness to pay and willingness to accept: how much can they differ? *American Economic Review*, 81, 635-647.

Huppert, F.A., Whittington, J.E. (2003). Evidence for the independence of positive and negative well-being: Implications for quality of life assessment, *British Journal of Health Psychology*, 8, 107-122. Johannesson, M. (1995). The relationship between cost-effectiveness analysis and cost-benefit analysis. *Social Science & Medicine*, 41, 483-489.

Johansson-Stenman, O., Martinsson, P. (2008). Are some lives more valuable? An ethical preferences approach, *Journal of Health Economics*, 27, 739-752.

Kahneman, D., Knetsch, J.L., Thaler, R.H. (1990). Experimental tests of the endowment effect and the coarse theorem, *Journal of Political Economy*, 98, 1325-1348.

Kahneman, D., Krueger, A.B., Schkade, D., Schwarz, N, Stone, A.A. (2006). Will you be happier if you were richer? A focusing illusion, *Science*, 30, 1908-1910.

Kahneman, D., Sugden, R. (2005). Experienced Utility as a Standard of Policy Evaluation, *Environmental & Resource Economics*, 32(1), 161-181.

Kahneman, D., Tversky, A. (1979). Prospect theory: an analysis of decision under risk, *Econometrica*, 47, 263-291.

Kahneman, D, Wakker, P.P. , Sarin, R. (1997). Back to Bentham? Explorations of Experienced Utility, *Quarterly Journal of Economics*, 112(2), 375-405.

Kartman, B., Stålhammer, N-O., Johannesson, M. (1998). Valuation of health changes with the contingent valuation method: A test of scope and question of order effects, *Health Economics*, 5, 531-541.

Klose T. (1999). The contingent valuation method in health care. *Health Policy*, 47, 97–123.

Knight, M., Stewart-Brown, S., Fletcher, L. (2001). Estimating health needs: The impact of a checklist of conditions and quality of life measurement on health information derived from community surveys. *Journal of Public Health Medicine*, 23(3), 179-186.

Kriegsman, D.M., Penninx, B.W., van Eijk, J.T., Boeke, A.J., Deeg, D.J. (1996). Self-reports and general practitioner information on the presence of chronic diseases in community dwelling elderly. *Journal of Clinical Epidemiology*, 49(12), 1407-1417.

Layard, R., Mayraz, G., Nickell, S. (2008). The marginal utility of income. *Journal of Public Economics*, 92, 1846-1857.

Liu, J-T, Hammitt, J.K., Wang, J-D, Liu, J-L. (2000). Mother's willingness to pay for her and her child's health: a contingent valuation study in Taiwan, *Health Economics*, 9, 319-326.

Luechinger, S.(2009). Valuing air quality using the life satisfaction approach, *Economic Journal*, 119, 482-515.

Luechinger, S., Raschky, P.A. (2009). Valuing flood disasters using the life satisfaction approach, *Journal of Public Economics*, 93, 620-633.

Luttmer, E.F.P. (2005). Neighbors as negatives: Relative earnings and well-being, *Quarterly Journal of Economics*, 120, 963-1002.

Mentzakis, E. (2011). Allowing for heterogeneity in monetary subjective well-being valuations. *Health Economics*, 20, 331–347.

Moore, S.; Shepherd, J.P. (2006). The cost of fear: Shadow pricing the intangible costs of crime, *Applied Economics*, 38, 293-300.

Mundlak, Y. (1978). On the pooling of time-series and cross-section data, *Econometrica*, 46, 69-85.O'Brien, B., Gafni, A. (1996). When do the "*dollars*" m*ake sense*? Toward a conceptual framework for contingent valuation studies in health care. *Medical Decision Making*, 16, 288-299.

O'Brien, B.J., Gertsen, K., Willam, A.R., Faulkner, L.A. (2002). Is there a kink in consumers' threshold value for cost-effectiveness in health care? *Health Economics*, 11, 175-180.

Oswald, A.J.; Powdthavee, N. (2007). Obesity, unhappiness, and the challenge of affluence: Theory and evidence, *Economic Journal*, 117, 441-454.

Oswald, A.J.; Powdthavee, N. (2008). Death, happiness, and the calculation of compensatory damages, *Journal of Legal Studies*, 37(S2), S217-S252.

Paloyo, A.R. (2009). *Co-pay and feel okay: Evidence of illusory health gains from a health insurance reform*. Ruhr Economic Paper No. 142.

Pevalin, D.J.; Ermisch, J. (2004). Cohabiting unions, repartnering and mental health, *Psychological Medicine*, 34, 1553-1559.

Pinto-Prades, J.L., Loomes, G., Brey, P. (2009). Trying to estimate a monetary value for the QALY. *Journal of Health Economics*, 28, 553-562.

Powdthavee, N. (2005). Unhappiness and crime: evidence from South Africa, *Economica*, 72, 531-547.

Powdthavee, N. (2008). Putting a price tag on friends, relatives, and neighbours: Using surveys of life satisfaction to value social relationships, *Journal of Socio-Economics*, 37, 1459-1480.

Powdthavee, N. (2009). Ill-health as a household norm: Evidence from other people's health problems, *Social Science & Medicine*, 68, 251-259.

Powdthavee, N.; Vignoles, A. (2008). Mental health of parents and life satisfaction of children: A within-family analysis of intergenerational transmission of well-being, *Social Indicators Research*, 88, 397-422.

Rawlins, M.D., Culyer, A.J. (2004). National Institute for Clinical Excellence and its value judgments, *British Medical Journal*, 329, 224–227.

Robinson, K.L., McBeth, J.; MacFarlane, G.J. (2004). Psychological distress and premature mortality in the general population: A prospective study, *Annals of Epidemiology*, 14, 467-472.

Sacker, A., Wiggins, R.D., Clarke, P., Bartley, M. (2003). Making sense of symptom checklists: A latent class approach to the first 9 years of the British Household Panel Survey. *Journal of Public Health Medicine* 25(3), 215-222.

Schkade, D.A., Kahneman, D. (1998). Does living in California make people happy? A focusing illusion in judgment of life satisfaction. *Psychological Science*, 9, 340-346.

Smith, R.D. (2003). Construction of the contingent valuation market in health care: a critical assessment, *Health Economics*, 12, 609–628.

Smith, R.D., Richardson, J. (2005). Can we estimate the 'social' value of a QALY? Four core issues to resolve, *Health Policy*, 74, 77-84.

Stewart, J.M., O'Shea, E., Donaldson, C., Shackley, P. (2002). Do ordering effects matter in willingness-to-pay studies of health care? *Journal of Health Economics*, 21, 585-599.

Taylor, M. F., Brice, J., Buck, N., Prentice-Lane, E., 2002. *British Household Panel Survey User Manual*. Colchester: University of Essex.

Tsuchiya, A., Williams, A. (2001). Welfare economics and economic evaluation. In: Economic evaluation in health care: merging theory with practice (eds: Drummond, M.F., McGuire, A.). Oxford University Press, 27-28.

Van den Berg, B., Bleichrodt, H., Eeckhoudt, L. (2005). The economic value of informal care: a study of informal caregivers' and patients' willingness to pay and willingness to accept for informal care. *Health Economics*, 14, 363-376.

Van den Berg, B., Ferrer-i-Carbonell, A. (2007). Monetary valuation of informal care: the well-being valuation method, *Health Economics*, 16, 1227-1244.

Van der Star, S.M., Van den Berg, B. (2010) Individual responsibility and health-risk behaviour: A contingent valuation study from the ex ante societal perspective. *Health Policy*, forthcoming.

Van Praag, B.M.S, Baarsma, B. (2005) Using happiness surveys to value intangibles: the case of airport noise. *Economic Journal*, 115, 224-246.

Viscusi, W.K., Aldy, J.E. (2003). The value of a statistical life: A critical review of market estimates throughout the world. *Journal of Risk and Uncertainty*, 27, 5–76.

Viscusi, W.K. (1993). The value or risks to life and health. *Journal of Economic Literature,* 31, 1912-1946.

Viscusi, W.K. (2010). The heterogeneity of the value of statistical life: Introduction and overview. *Journal of Risk and Uncertainty*, 40, 1-13.

Table 1: Descriptive Statistics: BHPS, 1996-2008

	M	SD	Range
Life satisfaction	5.16	1.25	1-7
Inverse GHQ (mental well-being)	24.75	5.58	0-36
Satisfaction with health	5.00	1.55	1-7
Self-assessed health	3.87	0.92	1-5
Ln(real equivalent household income)	9.56	0.72	1-13.36
Problems connected with: arms, legs, hand, feet, back, etc.	0.22	0.41	0-1
Difficulty in seeing (other than needing glasses to read)	0.03	0.18	0-1
Difficulty in hearing	0.05	0.22	0-1
Skin conditions/allergies	0.13	0.33	0-1
Chest/breathing problems, asthma, bronchitis	0.12	0.33	0-1
Heart/blood pressure or blood circulation problems	0.11	0.31	0-1
Stomach/liver/kidneys or digestive problems	0.07	0.25	0-1
Diabetes	0.02	0.15	0-1
Depression, anxiety	0.08	0.27	0-1
Alcohol or drug related problems	0.01	0.07	0-1
Epilepsy	0.01	0.09	0-1
Migraine or frequent headaches	0.09	0.29	0-1
Other health problems not listed	0.04	0.21	0-1
Health limits daily activities	0.14	0.34	0-1
Health limits amount or type of work	0.15	0.36	0-1

Note: N = 104,537.

Table 2: Random Effects Well-Being Regression Estimates: BHPS 1996-2008

	LS	IGHQ	HS	SAH
Health shocks, i.e. current health problems				
Problems connected with: arms, legs, hand, feet, back, etc.	-0.035	-0.253	-0.246	-0.175
	[0.011]**	[0.051]**	[0.012]**	[0.007]**
Difficulty in seeing (other than needing glasses to read)	-0.060	-0.155	-0.057	-0.057
	[0.020]**	[0.096]	[0.023]*	[0.014]**
Difficulty in hearing	-0.079	-0.178	-0.065	-0.050
	[0.021]**	[0.101]+	[0.024]**	[0.014]**
Skin conditions/allergies	-0.039	-0.031	-0.022	-0.036
	[0.013]**	[0.062]	[0.015]	[0.009]**
Chest/breathing problems, asthma, bronchitis	-0.047	-0.280	-0.233	-0.197
	[0.016]**	[0.074]**	[0.018]**	[0.011]**
Heart/blood pressure or blood circulation problems	-0.048	-0.368	-0.277	-0.229
	[0.015]**	[0.072]**	[0.017]**	[0.010]**
Stomach/liver/kidneys or digestive problems	-0.056	-0.327	-0.333	-0.271
	[0.016]**	[0.075]**	[0.018]**	[0.011]**
Diabetes	-0.101	-0.242	-0.332	-0.281
	[0.038]**	[0.181]	[0.044]**	[0.026]**
Depression, anxiety	-0.473	-3.930	-0.514	-0.355
	[0.015]**	[0.072]**	[0.018]**	[0.010]**
Alcohol or drug related problems	-0.237	-1.519	-0.211	-0.163
	[0.053]**	[0.253]**	[0.062]**	[0.036]**
Epilepsy	-0.038	-0.156	-0.200	-0.161
	[0.073]	[0.347]	[0.084]*	[0.050]**
Migraine or frequent headaches	-0.096	-0.619	-0.125	-0.121
	[0.015]**	[0.071]**	[0.017]**	[0.010]**
Other health problems not listed	-0.086	-0.577	-0.458	-0.356
	[0.017]**	[0.080]**	[0.019]**	[0.011]**
Average health problems over time				
Problems connected with: arms, legs, hand, feet, back, etc.	-0.022	-0.101	-0.223	-0.108
	[0.027]	[0.111]	[0.029]**	[0.016]**
Difficulty in seeing (other than needing glasses to read)	-0.066	-0.473	-0.142	-0.031
	[0.054]	[0.223]*	[0.059]*	[0.032]
Difficulty in hearing	0.025	-0.050	-0.081	-0.031
	[0.041]	[0.173]	[0.045]+	[0.024]
Skin conditions/allergies	-0.003	-0.053	-0.088	-0.023
	[0.028]	[0.115]	[0.030]**	[0.016]
Chest/breathing problems, asthma, bronchitis	-0.047	-0.071	-0.116	-0.083
	[0.028]+	[0.118]	[0.031]**	[0.017]**
Heart/blood pressure or blood circulation problems	-0.017	-0.035	-0.171	-0.063
	[0.031]	[0.130]	[0.034]**	[0.018]**
Stomach/liver/kidneys or digestive problems	-0.182	-0.823	-0.322	-0.184
	[0.038]**	[0.157]**	[0.041]**	[0.022]**
Diabetes	0.050	0.199	-0.042	0.005
	[0.060]	[0.258]	[0.067]	[0.037]
Depression, anxiety	-0.707	-2.464	-0.360	-0.121
	[0.036]**	[0.148]**	[0.039]**	[0.021]**
Alcohol or drug related problems	-0.509	-0.512	-0.328	-0.145
	[0.112]**	[0.470]	[0.122]**	[0.067]*

Epilepsy	-0.084	0.279	0.080	0.027
	[0.103]	[0.452]	[0.115]	[0.064]
Migraine or frequent headaches	-0.053	-0.510	-0.124	-0.040
	[0.033]	[0.137]**	[0.036]**	[0.019]*
Other health problems not listed	-0.104	0.084	-0.338	-0.178
	[0.049]*	[0.202]	[0.053]**	[0.029]**
Other health states				
Health limits daily activities	-0.215	-1.292	-0.662	-0.406
	[0.015]**	[0.070]**	[0.017]**	[0.010]**
Health limits amount or type of work	-0.113	-0.730	-0.401	-0.287
	[0.015]**	[0.070]**	[0.017]**	[0.010]**
Average health limits daily activities over time	-0.162	-0.223	-0.388	-0.252
	[0.044]**	[0.183]	[0.048]**	[0.026]**
Average health limits amount or type of work over time	-0.113	-0.730	-0.401	-0.287
	[0.015]**	[0.070]**	[0.017]**	[0.010]**
Income variables				
Ln(real equivalent household income)	0.014	-0.048	-0.008	-0.004
	[0.006]*	[0.030]	[0.007]	[0.004]
Average log equivalent household income over time	0.096	0.244	0.025	0.059
	[0.012]**	[0.052]**	[0.013]+	[0.007]**
Regional fixed effects	Yes	Yes	Yes	Yes
Wave fixed effects	Yes	Yes	Yes	Yes
Observations	104,537	104,537	104,537	104,537
Individuals	22,169	22,169	22,169	22,169
R-squared	0.1720	0.1989	0.3454	0.4184

Note: +<10%; *<5%; **<1%. LS = life satisfaction (1 = very dissatisfied,..., 7 = very satisfied); IGHQ = inversed GHQ-12 or mental well-being (0 = lowest mental well-being, ..., 3 = highest mental well-being); HS = health satisfaction (1 = very dissatisfied,..., 7 = very satisfied); SAH = self-assessed health compared to other people of the same age group (1 = very poor health, ..., 5 = excellent health). Standard errors are in parentheses. All self-reported health problems are represented by dummy variables with a value of 1 if the respondent reported to have that particular health condition and 0 otherwise. Control variables include age, age-squared, gender, employment dummies, education dummies, marital status, number of dependent children, regional and wave fixed effects.

Table 3: Level effects of health problems and income obtained from Table 2

	LS	IGHQ	HS	SAH
Panel A	**Level effects of health problems: $\beta + \theta$**			
Problems connected with: arms, legs, hand, feet, back, etc.	-0.056 [0.025]*	-0.354 [0.098]**	-0.469 [0.027]**	-0.283 [0.014]**
Difficulty in seeing (other than needing glasses to read)	-0.126 [0.050]**	-0.628 [0.201]**	-0.199 [0.054]**	-0.088 [0.028]**
Difficulty in hearing	-0.054 [0.035]	-0.228 [0.139]	-0.146 [0.038]**	-0.081 [0.019]**
Skin conditions/allergies	-0.042 [0.024]+	-0.084 [0.096]	-0.110 [0.026]**	-0.059 [0.013]**
Chest/breathing problems, asthma, bronchitis	-0.094 [0.023]**	-0.351 [0.091]	-0.349 [0.025]**	-0.280 [0.013]**
Heart/blood pressure or blood circulation problems	-0.066 [0.027]*	-0.403 [0.109]**	-0.448 [0.029]**	-0.292 [0.015]**
Stomach/liver/kidneys or digestive problems	-0.238 [0.035]**	-1.150 [0.138]**	-0.655 [0.037]**	-0.455 [0.019]**
Diabetes	-0.051 [0.046]	-0.043 [0.185]	-0.374 [0.050]**	-0.276 [0.026]**
Depression, anxiety	-1.180 [0.033]**	-6.394 [0.130]**	-0.874 [0.035]**	-0.476 0.018]**
Alcohol or drug related problems	-0.746 [0.098]**	-2.031 [0.394]**	-0.539 [0.105]**	-0.308 [0.056]**
Epilepsy	-0.122 [0.073]+	0.123 [0.290]	-0.120 [0.078]	-0.134 [0.041]**
Migraine or frequent headaches	-0.149 [0.029]**	-1.129 [0.186]**	-0.249 [0.031]**	-0.161 [0.016]**
Other health problems not listed	-0.190 [0.046]**	-0.493 [0.186]**	-0.796 [0.049]**	-0.534 [0.026]**
Health limits daily activities	-0.377 [0.042]**	-1.515 [0.170]**	-1.050 [0.045]**	-0.658 [0.024]**
Health limits amount or type of work	-0.099 [0.042]*	-0.337 [0.167]*	-0.539 [0.045]**	-0.336 [0.024]**
Panel B	**Level effects of income: $(\gamma + \delta)$**			
Ln(real equivalent household income)	0.110 [0.011]**	0.196 [0.045]**	0.018 [0.011]+	0.055 [0.006]**

Note: +<10%; *<5%; **<1%. See Table 2. All self-reported health problems are represented by dummy variables with a value of 1 if the respondent reported to have that particular health condition and 0 otherwise.

Table 4: Internal Rankings of Health Problems by Well-Being Measures

Ordinal ranking of health problems	LS	IGHQ	HS	SAH
Problems connected with: arms, legs, hand, feet, back, etc.	12	9	7	8
Difficulty in seeing (other than needing glasses to read)	8	6	12	13
Difficulty in hearing	13	12	13	14
Skin conditions/allergies	15	13	15	15
Chest/breathing problems, asthma, bronchitis	10	10	10	9
Heart/blood pressure or blood circulation problems	11	8	8	7
Stomach/liver/kidneys or digestive problems	4	4	4	4
Diabetes	14	14	9	10
Depression, anxiety	1	1	2	3
Alcohol or drug related problems	2	2	6	6
Epilepsy	9	15	14	12
Migraine or frequent headaches	7	5	11	11
Other health problems not listed	6	7	3	2
Health limits daily activities	3	3	1	1
Health limits amount or type of work	5	11	5	5
Correlation matrix	**LS**	**IGHQ**	**HS**	**SAH**
LS	1.000	0.814	0.739	0.750
IGHQ		1.000	0.679	0.632
HS			1.000	0.979
SAH				1.000

Note: LS = life satisfaction (1 = very dissatisfied,..., 7 = very satisfied); IGHQ = inversed GHQ-12 or mental well-being (0 = lowest mental well-being, ..., 3 = highest mental well-being); HS = health satisfaction (1 = very dissatisfied,..., 7 = very satisfied); SAH = self-assessed health compared to other people of the same age group (1 = very poor health, ..., 5 = excellent health). All self-reported health problems are represented by dummy variables with a value of 1 if the respondent reported to have that particular health condition and 0 otherwise.

Table 5: Shadow Prices of Health Problems and Conditions

Shadow Prices (SPs)	LS	IGHQ	HS	SAH
Problems connected with: arms, legs, hand, feet, back, etc.	£7	£51	£2.67E+12	£1,657
Difficulty in seeing (other than needing glasses to read)	£21	£236	£703,647	£39
Difficulty in hearing	£6	£22	£36,747	£33
Skin conditions/allergies	£5	£5	£4,794	£19
Chest/breathing problems, asthma, bronchitis	£13	£50	£3.29E+09	£1,586
Heart/blood pressure or blood circulation problems	£8	£68	£8.10E+11	£1,951
Stomach/liver/kidneys or digestive problems	£77	£3,522	£8.93E+16	£38,050
Diabetes	£6	£2	£1.32E+10	£1,482
Depression, anxiety	£455,131	£1.46E+15	£1.97E+22	£54,413
Alcohol or drug related problems	£8,844	£316,600	£1.36E+14	£2,636
Epilepsy	£20	-£5	£8,062	£102
Migraine or frequent headaches	£29	£3,165	£1.12E+07	£177
Other health problems not listed	£46	£114	£2.50E+20	£159,587
Health limits daily activities	£298	£22,738	£3.86E+26	£1.47E+06
Health limits amount or type of work	£15	£46	£1.37E+14	£4,359

Note: All figures are in £1,000 per annum and are calculated based on the sample average real equivalent household income of £10,000 per annum.

Table 6: External Rankings of Health Problems By Well-Being Measures

External ranking	Internal ranking	Health problems	SPs	95% Confidence intervals
1	1	Health limits daily activities (HS)	£3.86E+26	[-2.91e+28, 2.99e+28]
2	2	Depression, anxiety (HS)	£1.97E+22	[-1.24e+24, 1.28e+24]
3	3	Other health problems not listed (HS)	£2.50E+20	[-1.42e+22, 1.47e+22]
4	4	Stomach/liver/kidneys or digestive problems (HS)	£8.93E+16	[-4.17e+18, 4.35e+18]
5	1	Depression, anxiety (IGHQ)	£1.46E+15	[-1.99e+16, 2.28e+16]
6	5	Health limits amount or type of work (HS)	£1.37E+14	[-5.31e+15, 5.58e+15]
7	6	Alcohol or drug related problems (HS)	£1.36E+14	[-5.46e+15, 5.73e+15]
8	7	Problems connected with: arms, legs, hand, feet, back, etc. (HS)	£2.67E+12	[-8.88e+13, 9.41e+13]
9	8	Heart/blood pressure or blood circulation problems (HS)	£8.10E+11	[-2.57e+13, 2.73e+13]
10	9	Diabetes (HS)	£1.32E+10	[-3.53e+11, 3.79e+11]
11	10	Chest/breathing problems, asthma, bronchitis (HS)	£3.29E+09	[-8.10e+10, 8.76e+10]
12	11	Migraine or frequent headaches (HS)	£1.12E+07	[-1.95e+08, 2.17e+08]
13	1	Health limits daily activities (SAH)	£1.47E+06	[-2631676, 5572066]
14	12	Difficulty in seeing (other than needing glasses to read) (HS)	£703,647	[-1.04e+07, 1.18e+07]
15	1	Depression, anxiety (LS)	£455,131	[-539208.1, 1449470]
16	2	Alcohol or drug related problems (IGHQ)	£316,600	[-1639085, 2272284]
17	2	Other health problems not listed (SAH)	£159,587	[-214465.6, 533639]
18	3	Depression, anxiety (SAH)	£54,413	[-57699.96, 166525.5]
19	4	Stomach/liver/kidneys or digestive problems (SAH)	£38,050	[-36782.94, 112883.8]
20	13	Difficulty in hearing (HS)	£36,747	[-383611.1, 457104.7]
21	3	Health limits daily activities (IGHQ)	£22,738	[-64432.94, 109908]
22	2	Alcohol or drug related problems (LS)	£8,844	[-10837.22, 28524.35]
23	14	Epilepsy (HS)	£8,062	[-90685.93, 106809.6]
24	15	Skin conditions/allergies (HS)	£4,794	[-35804.15, 45392.98]
25	5	Health limits amount or type of work (SAH)	£4,359	[-2805.341, 11524.02]
26	4	Stomach/liver/kidneys or digestive problems (IGHQ)	£3,522	[-6895.342, 13939.52]
27	5	Migraine or frequent headaches (IGHQ)	£3,165	[-5803.038, 12132.6]
28	6	Alcohol or drug related problems (SAH)	£2,636	[-3653.141, 8924.529]
29	7	Heart/blood pressure or blood circulation problems (SAH)	£1,951	[-592.6903, 4495.141]
30	8	Problems connected with: arms, legs, hand, feet, back, etc. (SAH)	£1,657	[-420.638, 3735.04]

31	9	Chest/breathing problems, asthma, bronchitis (SAH)	£1,586	[-375.841, 3547.107]
32	10	Diabetes (SAH)	£1,482	[-676.964, 3640.733]
33	3	Health limits daily activities (LS)	£298	[-9.965, 605.619]
34	6	Difficulty in seeing (other than needing glasses to read) (IGHQ)	£236	[-375.186, 848.007]
35	11	Migraine or frequent headaches (SAH)	£177	[12.286, 341.458]
36	7	Other health problems not listed (IGHQ)	£114	[-153.582, 381.876]
37	12	Epilepsy (SAH)	£102	[-71.850, 275.700]
38	4	Stomach/liver/kidneys or digestive problems (LS)	£77	[12.244, 142.411]
39	8	Heart/blood pressure or blood circulation problems (IGHQ)	£68	[-42.739, 178.980]
40	9	Problems connected with: arms, legs, hand, feet, back, etc. (IGHQ)	£51	[-26.474, 127.862]
41	10	Chest/breathing problems, asthma, bronchitis (IGHQ)	£50	[-23.306, 123.393]
=42	5	Other health problems not listed (LS)	£46	[-3.735, 96.278]
=42	11	Health limits amount or type of work (IGHQ)	£46	[-59.342, 151.006]
44	13	Difficulty in seeing (other than needing glasses to read) (SAH)	£39	[-13.646, 91.989]
45	14	Difficulty in hearing (SAH)	£33	[-.355, 65.801]
46	6	Migraine or frequent headaches (LS)	£29	[5.989, 51.562]
47	12	Difficulty in hearing (IGHQ)	£22	[-25.810, 69.814]
48	7	Difficulty in seeing (other than needing glasses to read) (LS)	£21	[-7.635, 50.367]
49	8	Epilepsy (LS)	£20	[-19.785, 60.436]
50	15	Skin conditions/allergies (SAH)	£19	[3.493, 34.864]
51	9	Health limits amount or type of work (LS)	£15	[-4.337, 33.669]
52	10	Chest/breathing problems, asthma, bronchitis (LS)	£13	[3.026, 23.776]
53	11	Heart/blood pressure or blood circulation problems (LS)	£8	[-.965, 17.310]
54	12	Problems connected with: arms, legs, hand, feet, back, etc. (LS)	£7	[-.878, 14.207]
=55	13	Difficulty in hearing (LS)	£6	[-4.034, 16.825]
=55	14	Diabetes (LS)	£6	[-7.444, 19.243]
=57	13	Skin conditions/allergies (IGHQ)	£5	[-9.744, 20.382]
=57	15	Skin conditions/allergies (LS)	£5	[-1.789, 11.059]
59	14	Diabetes (IGHQ)	£2	[-20.616, 25.559]
60	15	Epilepsy (IGHQ)	-£5	[-20.223, 10.9012]

Note: All figures are in £1,000 and are calculated based on the sample average real equivalent household income of £10,000 per annum.

Table A1: Correlation matrix of reported health problems

	hlprba	hlprbb	hlprbc	hlprbd	hlprbe	hlprbf	hlprbg	hlprbh	hlprbi	hlprbj	hlprbk	hlprbl	hlprbm
hlprba	1.000												
hlprbb	0.119	1.000											
hlprbc	0.112	0.090	1.000										
hlprbd	0.064	0.036	0.022	1.000									
hlprbe	0.110	0.065	0.052	0.138	1.000								
hlprbf	0.178	0.091	0.076	0.022	0.095	1.000							
hlprbg	0.142	0.069	0.056	0.068	0.096	0.121	1.000						
hlprbh	0.075	0.073	0.027	-0.003	0.045	0.182	0.039	1.000					
hlprbi	0.158	0.076	0.052	0.069	0.107	0.115	0.149	0.044	1.000				
hlprbj	0.025	0.023	0.014	0.016	0.043	0.017	0.054	-0.002	0.127	1.000			
hlprbk	0.023	0.026	0.001	0.000	0.024	0.016	0.013	0.000	0.036	0.008	1.000		
hlprbl	0.102	0.056	0.032	0.077	0.058	0.045	0.097	0.001	0.151	0.008	0.027	1.000	
hlprbm	0.064	0.037	0.021	0.025	0.031	0.035	0.044	0.014	0.060	0.002	0.014	0.047	1.000

Note: hlprba = problems connected with: arms, legs, hand, feet, back, etc.; hlprbb = difficulty in seeing (other than needing glasses to read); hlprbc = difficulty in hearing; hlprbd = skin conditions/allergies; hlprbe = chest/breathing problems, asthma, bronchitis; hlprbf = heart/blood pressure or blood circulation problems; hlprbg = stomach/liver/kidneys or digestive problems; hlprbh = diabetes; hlprbi = depression, anxiety; hlprbj = alcohol or drug related problems; hlprbk = epilepsy; hlprbl = migraine or frequent headaches; hlprbm = other health problems not listed.

Table A2: Correlation coefficients between current and average health problems

Health problems	Correlation coefficients
Problems connected with: arms, legs, hand, feet, back, etc.	0.779
Difficulty in seeing (other than needing glasses to read)	0.669
Difficulty in hearing	0.812
Skin conditions/allergies	0.785
Chest/breathing problems, asthma, bronchitis	0.848
Heart/blood pressure or blood circulation problems	0.811
Stomach/liver/kidneys or digestive problems	0.730
Diabetes	0.887
Depression, anxiety	0.755
Alcohol or drug related problems	0.752
Epilepsy	0.916
Migraine or frequent headaches	0.775
Other health problems not listed	0.626
Health limits daily activities	0.789
Health limits amount or type of work	0.806