Subjective Health Evaluation
-Advanced Model and International Comparison-

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Abstract

In this paper, we attempt to calculate the "quality of life" (QOL) from subjective health evaluations in Japan, following Cutler and Richardson (1997) and Groot (2000). We then extend the model in several ways. First, whereas previous studies define the domain of QOL in an ad hoc manner, i.e. excluding "excellent" or "very poor" respondents, we suggest a more rigorous alternative measure. Second, the heterogeneity among individuals that is inevitable in micro-data is accounted for in the estimation process. The estimation results are shown as follows: using the same model as previous works, similar tendencies are found, but coefficients are smaller for many symptoms and diseases. Economic variables help to clarify the effect of symptoms or diseases on subjective health evaluation. The QOL measures defined in this paper are smaller for most symptoms and diseases, and thus the measures in previous research are likely to under-estimate QOL based on symptoms and diseases. Our model seems to be, therefore, more suitable.

1 Introduction

Cost-effectiveness analysis has been widely used in evaluation of new medical technology and in analysis of health policy. Although quality-adjusted life-years (QALYs), disability-adjusted life-years (DALYs) and other methods have been used to measure outcomes, each method has specific issues that need to be clarified. The Rating Scale, the Standard Gamble and the Time Trade-Off are the most widely used methods (Torrance(1986)).

In the Rating Scale approach, there are several ways to ask subjects to describe their preferences. The scale can have numbers, categories, or a ten-centimeter line on a page. Health states are then indicated by the subject between two clearly defined endpoints on a line, with the most preferred state at one end and the least preferred at the other. Although this method is relatively easy for subjects to understand, it is subject to measurement biases.

The Standard Gamble measure asks for a preference under uncertainty. Alternative 1 is a treatment for a given health state with two possible outcomes: to live healthily for an additional *t*years with probability *p*, and to die immediately with probability (1-*p*). Alternative 2 is to live an additional *t* years with the given state. Probability *p* is varied until the respondent feels indifferent between two alternatives, and the preference score for the health state is *p*. This is based on the fundamental axioms of utility theory of Von Neumann and Morgenstern and, although theoretically justified, it is complicated for the general population to comprehend.

The Time Trade-Off method asks subjects to select from two alternatives. One is to live with state *i* for *t* years, followed by death, and the other is to live healthily for *x* years (where $x<t$) followed by death. *x* is varied until the respondent is indifferent between two alternatives. The preference for state *i* is x/t. This also has some minor difficulties (Drummond, O'Brien, Stoddart and Torrance(1986), Cutler and Richardson(1997)).

When the focus of analysis is on the whole of society or other aggregates, for both technical and cost considerations, it is no longer possible to ask such complex

questions. Subjective health status analysis is an efficient approach, but several issues remain. As the answer is subjective, comparability among different individuals is problematic, i.e. it is impossible to sum up across a whole society. Fortunately, surveys of this kind have been performed over a long period, and some knowledge about bias caused by age and gender has been collected (Cutler and Richardson(1997), Groot(2000), Kenkel(1995), Kerkhofs and Lideboom(1995)).

What is of more concern in the evaluation of disease-related cost and medicine is the subjective adaptation to illness. The longer a person suffers from a disease, the smaller is the loss caused by the disease likely to be recognized. This tendency is not specific to this kind of model, and is also observed in QOL evaluations involving differences between people with and without a disease (Ubel, Richardson and Menzel(2000)).

In this paper, we try to calculate QOL from subjective health evaluations in Japan following Cutler and Richardson(1997) and Groot(2000), and then extend the model in several ways. First, whereas previous studies define the domain of QOL in an ad hoc manner, i.e. excluding "excellent" or "very poor" respondents, this paper suggests a more rigorous alternative measure. Second, heterogeneity among individuals, which is inevitable in micro-data, is accounted for in the estimation process. Third, economic variables such as income or job status are used as variables.

The next section explains the data used in this paper. Section 3 shows the proposed estimation models. Section 4 defines the QOL, and Sections 5 and 6 show the results of the estimation of QOL.

2 Data

A Comprehensive Survey of the Living Condition of People on Health and Welfare has been conducted every three years since 1986. The purpose of the survey is to investigate health, medical services, pensions, welfare, incomes and other factors affecting living standards. Questionnaires have four components: household, individual, income and savings. About 780,000 individuals (280,000 households), selected at random, were evaluated in the household and individual components. The income and savings surveys covered about 120,000 individuals (40,000 households), also selected at random. The data used in this study were collected in 1992, 1995 and 1998.

Subjective health responses ranged from excellent to good, fair, poor and very poor. In previous studies, respondents were asked to evaluate their health in comparison with their age peers. Note that in Cutler and Richardson(1997), subjective health was measured in the opposite order.

Symptoms and diseases were surveyed in more detail than in other studies. The symptoms listed were shown in table 1, such as fever, coughs, stomach ache and so on. The respondents marked each of the symptoms that applied to them, but the survey did not have the means of providing information about whether they had considered seeing a doctor, or the seriousness of the symptoms.

Disease options listed that they might have suffered from and were consulting a doctor about were also shown in table 1, such as diabetes, stroke, angina/AMI and so on. The respondents also marked the symptoms in a multiple fashion, and indicated the one that was of most concern to them at the time.

3 Models for estimation

The basic models following previous studies were as follows. The dependent variable H_i was defined as 1 when the i th individual assessed their health to be excellent, 2 good, 3 fair, 4 poor and 5 very poor. The independent variables were as follows: the vector X_i represented demographic characteristics. D_i defined diseases they suffered; S_i indicated their symptoms. The estimation method was the ordered probit method with

$$H_i^* = \alpha_0 + X_i\alpha_X + D_i\alpha_D + S_i\alpha_S + \varepsilon_i$$

$$H_i = \begin{cases} 1 \;\; if \;\; H_i^* < 0 \\ 2 \;\; if \;\; H_i^* > 0 \;\; \& \;\; H_i^* < C_2 \\ 3 \;\; if \;\; H_i^* > C_2 \;\; \& \;\; H_i^* < C_3 \\ 4 \;\; if \;\; H_i^* > C_3 \;\; \& \;\; H_i^* < C_4 \\ 5 \;\; if \;\; H_i^* > C_4 \end{cases}$$

where C_1, the threshold between H_i=0 and H_i=1, is normalized to be 0.

Groot(2000) extended the ordered probit model to explain the change in the threshold of subjective health according to the following conditions:

$$H_i^* = \alpha_0 + X_i\alpha_X + D_i\alpha_D + S_i\alpha_S + \varepsilon_i$$

Table 1　QOL estimation

	1992	1995	1998
fever	0.995	0.990	0.997
fatigue	0.962	0.963	0.967
sore throat	0.993	0.993	
sleepless	0.984	0.970	0.990
irritation			0.989
failure to remember			1.004
headache	0.983	0.986	0.986
dizziness	0.988	0.955	0.984
bleary eyes	0.995	0.989	0.995
asthenopia	1.000	1.000	
difficulty in seeing			0.995
tinnitus	0.994	1.005	1.001
difficulty in hearing			0.997
otalgia	1.000	1.000	
palpitation	0.982	0.989	0.985
difficulty in breathing	0.983	0.984	0.995
chest pain	0.979	0.985	0.987
coughs	0.988	0.987	0.989
sputum expectoration	0.995	0.992	0.989
the sniffles	0.998	0.992	0.995
noisy breathing	0.985	0.987	0.990
retching	0.986	0.982	0.989
diarrhea	0.983	0.986	0.993
constipation	0.989	0.995	0.991
appetite lost	0.983	0.979	0.991
emesis	0.984	0.993	
nausea	1.003	1.001	
stomachache	0.978	0.970	0.975
hemorrhoids	0.996	0.992	0.989
toothache	1.013	1.007	1.007
dental problems	1.005	1.006	1.004
difficulty in chewing			1.003
rash	0.999	0.994	0.999
itching	1.005	1.002	1.004
stiff shoulder	0.993	0.986	0.991
back pain	0.981	0.983	0.987
sprain	1.011	1.010	
arthralgia	0.990	0.990	0.990
impairments of hands and feet	0.972	0.985	0.981
numbness	0.981	0.981	0.989
frigid hands and feet			0.997
foot edema			0.989
disuria	0.985	0.979	0.996
frequent urination	0.994	0.973	0.998
incontinence	0.991	0.977	0.996
paramenia/merorrhalgia	0.989	0.979	0.985
morning sickness	0.954	0.973	
flow	0.993	0.994	
fractures			1.004
injuries	1.013	1.011	1.013
others	0.987	0.989	0.991

	1992	1995	1998
diabetes	0.978	0.980	0.985
obesity			1.002
hyperlipidaemia			0.998
impairments of thyroid gland		0.983	0.992
dementia			0.975
psychosis	0.979	0.995	0.975
neurosis	0.966	0.980	0.981
depression	0.985	0.974	
autonomic imbalance	0.970	0.973	0.979
cataract			0.997
retinopathy			0.990
eye problems	0.998	1.000	
tympanitis			1.003
deafness			1.000
ear problems	0.996	0.992	
other nasal problems	1.000	1.014	
hypertension	0.993	0.993	0.992
hypotension	0.992	1.002	
stroke	0.967	0.963	0.975
angina/AMI	0.981	0.982	0.983
other circulatory problems	0.974	0.973	0.975
acute nasopharinxis	0.985	0.979	0.988
bronchitis	0.979	0.984	
allergic rhinitis	1.006	1.010	1.000
asthma	0.974	0.974	0.979
other respiratory problems	0.977	0.984	0.992
gastritis/duodenitis	0.988	0.986	0.986
gastric/duodenal ulcer	0.976	0.978	0.985
acute enterocolitis	0.976	0.991	
hepatitis/cirrhosis	0.970	0.973	0.980
cholecytolithiasis/cholesystitis	0.988	0.985	0.999
other digestive problems	0.972	0.971	0.978
decayed tooth	1.008	1.017	1.010
oral problems	0.996	1.000	0.996
other oral problem	1.000	1.003	
atopic dermatitis			0.998
contact dermatitis			1.006
urticaria			1.003
skin problems	1.011	1.010	
boldness			1.014
gout	0.989	1.000	1.003
chronic rheumatoid arthritis	0.979	0.983	0.972
arthropahy			0.994
stiff shoulder			1.000
back pain	0.988	0.987	0.987
neuralgia	0.986	0.988	
osteoporosis		0.985	0.986
kidney problems	0.972	0.958	0.979
prostatic hypertrophy	0.985	0.981	0.988
cystitis	0.988	1.002	
urinary organ problems	0.983	0.997	
premenopausal or post-menopausal problems			0.988
fractures	0.993	0.997	0.998
injuries	1.008	1.005	1.006
anemia/hemopathy	0.985	0.988	0.987
malignant tumor	0.986	0.969	0.982
pregnancy	1.004	0.999	1.002
geriatric problems	0.985	0.994	
others	0.984	0.988	0.992
unknown	0.973	0.987	0.984

$$H_i = \begin{cases} 1 \ if \ H_i^* < 0 \\ 2 \ if \ H_i^* > 0 \\ \quad \& \ H_i^* < \beta_0^2 + X_i\beta_X^2 + D_i\beta_D^2 + S_i\beta_S^2 \\ 3 \ if \ H_i^* > \beta_0^2 + X_i\beta_X^2 + D_i\beta_D^2 + S_i\beta_S^2 \\ \quad \& \ H_i^* < \beta_0^3 + X_i\beta_X^3 + D_i\beta_D^3 + S_i\beta_S^3 \\ 4 \ if \ H_i^* > \beta_0^3 + X_i\beta_X^3 + D_i\beta_D^3 + S_i\beta_S^3 \\ \quad \& \ H_i^* < \beta_0^4 + X_i\beta_X^4 + D_i\beta_D^4 + S_i\beta_S^4 \\ 5 \ if \ H_i^* > \beta_0^4 + X_i\beta_X^4 + D_i\beta_D^4 + S_i\beta_S^4 \end{cases}$$

Hereafter, eq. (1) is called the constant threshold model and eq. (2) the function threshold model.

In the following equation, the economic variables E_i were used in the estimation as an alternative specification. All the coefficients were then estimated by a heterogeneity consistent estimation method, which is appropriate for micro-data such as those used here.

4 QOL Definition

In previous studies, the effect of the *j* disease on QOL was defined in the constant threshold model as:

$$QOL^c_{CR,G} = 1 - \frac{\hat{\alpha}^j_D}{\hat{C}_4}$$

where > ^ indicated estimation and α^j_D was the coefficient of the *j*th disease dummy. To avoid unnecessary complexity, $\alpha^j_D > 0$ was assumed. In the function threshold model, QOL was defined as:

$$QOL^f_{CR,G} = 1 + \frac{Z_i\hat{\alpha}_Z}{Z_i\hat{\beta}^4_Z} - \frac{Z_i\hat{\alpha}_Z + \hat{\alpha}^j_D}{Z_i\hat{\beta}^4_Z + \hat{\beta}^{4j}_D} = -\frac{Z_i\hat{\beta}^4_Z\hat{\alpha}^j_D - Z_i\hat{\alpha}_Z\hat{\beta}^{4j}_D}{Z_i\hat{\beta}^4_Z(Z_i\hat{\beta}^4_Z + \hat{\beta}^{4j}_D)}$$

Formulations of this kind are easy to understand, but there are some problems. First, the domain of QOL is set in an ad hoc manner, i.e. excluding "excellent" or "very poor" respondents. Originally, the QOL concept required 0 to represent death and 1 to represent perfect health. Thus, all the respondents should be less than 1 and greater than 0. However, previous studies assigned 1 to "excellent" and 0 to "very poor". This is inconsistent with the QOL concept and QOL may thereby be overestimated. Second, the denominator may be very small in comparison with the numerator, and thus the QOL measure cannot be limited to [0,1], but it is obviously defined over d thus the QOL measure cannot be limited to [0,1], but it is obviously defined over he same across respondents. However, there is no evidence for this and it seems to be more natural to consider QOL as dependent upon the health status of the respondent. For example, the effects of flu differ between healthy young people and sick elderly people. To overcome such shortcomings, a new definition of QOL is proposed in this paper as

$$QOL_{HO} = 1 - \left\{\Phi(Z_i\hat{\alpha}_Z) - \Phi(Z_i\hat{\alpha}_Z + \hat{\alpha}^j_D)\right\}$$

where Φ is the cumulative distribution function of the standard normal distribution. This is better when comparing with $QOL^c_{CR,G}$ and $QOL^f_{CR,G}$ for several reasons. First, QOL_{HO} defines all the respondents without excluding "excellent" and "very poor". Second, QOL_{HO} is always below 1 and positive. Third, QOL differs among respondents even in the constant threshold model according to their health status. Fourth, QOL is evaluated according to the true distribution of QOL_{HO}, unlike $QOL^c_{CR,G}$ and $QOL^f_{CR,G}$. QOL_{HO} which is thought to have damaging or negative effects through the impact of certain symptoms or diseases on the QOL.

The term QOL_{HO} is a marginal effect of the dummy variables in the probit model. $QOL^c_{CR,G}$ and $QOL^f_{CR,G}$ define QOL between [-8, 8]. and cause the problem mentioned above.

Because QOL_{HO} varies among individuals, the social or aggregate QOL is:

$$\int \left\{1 - \left(\Phi(Z_i\hat{\alpha}_z) - \Phi(Z_i\hat{\alpha}_z + \hat{\alpha}^j_D)\right)\right\} f(di)$$

where f(•) represents the probability distribution function of individuals in this society.

5 Estimation Results

5.1 Check for Goodness-of-Fit

We first needed to check the goodness-of-fit before evaluating the results. For the ordered probit, especially the function threshold model, it is not obvious how to evaluate goodness-of-fit. Here, following Kenkel (1995), the estimated distribution of the subjective health evaluation was compared with the actual distribution for the purposes of verification.

The percentages in the distribution in the actual observation showed 5.44%, 13.22%, 43.94%, 32.87% and 4.51% for "excellent" to "very poor" respectively, and the estimated ones in the constant threshold model for all symptoms and sicknesses were 5.49%, 13.25%, 44.09%, 32.52% and 4.62%, and in the function threshold model they were 5.50%, 13.44%, 43.87%, 32.52% and 4.65%. Therefore, both were very similar and fitted well. As in the other estimated model with the economic variables

and the restrictive model, the results were almost the same, so that checking for goodness-of-fit has been omitted to save space.

5.2 Constant Threshold Model

For symptoms and diseases, almost all subjects showed worse health evaluation in 1998, although some symptoms and diseases raised health evaluation in significance, such as failure to remember, sniffles, toothache, dental problems, itching, wounds, hyperlipidemia, hypertension, allergic rhinitis, decayed teeth, oral problems, contact dermatitis, boldness and stiff shoulders. In the studies in the UK and USA, there were no such counter-intuitive cases. There are three possible explanations. First, the information provided on symptoms and diseases in the Japanese data set was more detailed than in the others. If a kind of symptom or sickness was typical at an earlier stage, or typically had co-morbidity with the others, its effect would be to raise health evaluation. Second, as this survey was conducted for the individual household member, as explained above, those who reported suffering a certain symptom or sickness would probably feel better than a hospitalized patient would. Hence, the health evaluation in this survey might have been contaminated by such a severe selection, but it does not reflect the whole impact of these symptoms and diseases. Third, and maybe the most important point, is that the reference group used by the respondents when they evaluated their health may have been falsely imagined. That is, the term “the same age group” was missing in the survey, though it had been included in the others. Thus, they may have compared their current situation with their situation when they were admitted to hospital. When surveyed they had been discharged and were enjoying better health, even though they had not recovered completely. In this case, biased sampling excluding in-patients caused counter-intuitive results.

5.3 The Function Threshold Model

Although symptoms or diseases consistent across all threshold functions were not found as significant by Groot(2000), our study shows that in 1998 there were several consistently significant variables, including marital status, bleary eyes, the sniffles, retching, appetite loss, stiff shoulders, back pain, paramenia/menorrhalgia, hypertension, other circulatory problems, and gastritis/duodenitis. Moreover, the coefficients for tinnitus, toothache, oral problems, difficulty in chewing, fractures, urticaria, gout and injuries were consistently negative but insignificant, and thus these symptoms or diseases raised the criteria for good health.

5.4 The Model with Economic Variables

In general, economic situations other than pure health conditions may also affect the health-related QOL, but the concept excludes such a non-health condition. Therefore, by estimating it using economic variables, we can control and eliminate the effect of economic conditions and thus measure the pure health-related QOL. If not, the estimated QOL is biased by the subjective economic situation.

Although our study shows that aging significantly reduces subjective health evaluation, many variables were almost the same as in the constant threshold model in 1998. On the other hand, in the function threshold model in 1998, the number of significant variables in the threshold function decreases. Only bleary eyes, the sniffles, retching, back pain, fracture, hypertension, and other circulatory problems were consistently significant in the threshold function model with economic variables.

5.5 Restrictive Estimation Comparing the UK and USA

Because the data set for Japan was more detailed than for the UK or the USA, comparisons between countries might be affected. To control for this problem, a model including restricted variables that is comparable with the UK and USA studies has been performed in this subsection.

In the constant threshold model, cataracts, hypertension, allergic rhinitis, atopic dermatitis, and contact dermatitis remain as counter-intuitive results, in which these diseases raise subjective health evaluation. On the other hand, the function threshold model shares results with the non-restrictive model, which means that there are many consistently significant variables in the threshold function, except for the sniffles. To conclude, such restriction does not have much effect and thus the more detailed information in Japan does not lead to counter-intuitive phenomena.

6 Estimation Results for QOL

Table 1 summarizes the QOL. In the case of diabetes, we observe values of 0.86 in the UK, 0.66 in the USA, and 0.95 in Japan. For hypertension, while it is 0.86 in USA, it is 1.004 in Japan.

Conversely, the QOL values for difficulty in seeing were 0.93, 0.92 and 0.985, and difficulty in hearing

Table 2 QOL comaparison between USA, UK and Japan

		USA	UK (constant threshold model)	Japan (constant threshold model)
Diseases	Arthritis	0.79		
	arthropathy			0.983
	chronic rheumatoid arthritis			0.885
	skin conditions, allergies	0.88	0.970	
	atopic dermatitis			1.012
	contact dermatitis			1.033
	urticaria			1.004
	Stomach, liver, kidney		0.80	
	gastritis/duodenitis			0.980
	gastric/duodenal ulcer			0.967
	hepatitis/cirrhosis			0.941
	kidney problems			0.906
	Diabetes	0.66	0.86	0.95
	other endocrine disorder	0.81		
	hypertension	0.86		1.004
	stroke	0.70		0.961
	angina/AMI	0.74		0.898
	other circulatory problems	0.80		0.956
	asthma	0.74		0.945
	bronchitis	0.86		
	acute nasopharinxis			0.970
	other respiratory problems	0.88		0.936
	deafness	0.930		0.981
	Nerves, anxiety, depression		0.79	
	psychosis			0.87
	neurosis			0.94
	autonomic imbalance			0.94
	cataract	0.97		1.00
	Orthopedic disorder	0.88		
	fractures			0.96
	injuries			1.00
Symptoms	difficulty in hearing		0.97	0.996
	difficulty in seeing	0.93	0.92	0.985
	Chest, breathing problems		0.83	
	coughs			0.976
	Heart, blood		0.84	
	palpitation			0.967
	difficulty in breathing			0.968
	chest pain			0.954
	Migraine, chronic headaches		0.94	0.957
	sinusitis	0.93		
	the sniffles			1.006

were 0.93, 0.97 and 0.996 in USA, UK and Japan, respectively. In some symptoms or diseases, the QOLs among countries were almost the same. However, for most symptoms or diseases, QOLs were higher in Japan than in UK and USA.

We present the result with restricted variables comparable in the constant threshold model with USA and UK in Table 2 and in the function threshold model with UK. Our results here also show smaller effects in QOL. QOL_{HO} is larger than the estimated $QOR_{CR,G}$ and the discrepancy indicates the possibility of systematic underestimation of QOL in the existing literature because of the appropriateness of QOL_{HO}, as discussed above.

7 Concluding Remarks

We have applied the same procedure as in the existing literature to Japan, and have improved upon it. First,

Table 3 QOL comparison between U.K. and Japan

		UK	Japan
Diseases	skin conditions, allergies	0.97	
	atopic dermatitis		1.008
	contact dermatitis		1.015
	urticaria		1.008
	Stomach, liver, kidney	0.78	
	gastritis/duodenitis		0.969
	gastric/duodenal ulcer		0.97
	hepatitis/cirrhosis		0.968
	kidney problems		0.969
	diabetes	0.86	0.979
	Nerves, anxiety, depression	0.82	
	psychosis		0.966
	neurosis		0.988
	autonomic imbalance		0.963
Symptoms	difficulty in hearing	0.96	0.988
	difficulty in seeing	0.96	0.982
	Chest, breathing problems	0.86	
	coughs		0.974
	Heart, blood	0.84	
	palpitation		0.965
	difficulty in breathing		0.974
	chest pain		0.966
	Migraine, chronic headaches	0.93	0.964

whereas the previous studies define the domain of QOL in an ad hoc manner, i.e. excluding "excellent" or "very poor" respondents, this paper suggests a more rigorous alternative measure. Second, heterogeneity among individuals, which is inevitable in micro-data, is accounted for in the estimation. Third, economic variables such as income or job status, which are considered to affect subjective health status, are also accounted for. The estimation results show that, in the same model as the previous ones, similar tendencies are found, but coefficients are smaller for many symptoms and diseases. Economic variables help to clarify the effect of symptoms or diseases on subjective health evaluation. QOL defined in this paper is larger for most symptoms and diseases, and thus the measures in the previous studies are likely to underestimate it and might not be appropriate.

As emphasized above, the most important difference between Japan and other surveys is the lack of the phrase "comparison with the same age group". This seems to contaminate the result heavily. To avoid biases in aging effect, surveys including such a phrase should be performed.

Finally, macro QOLs should be calculated for evaluating health care from social perspectives as they can be used in analyses of medical costs, and would be useful indices in evaluating population health such as Healthy-Life-Expectancy. Dynamics of QOL should be studied to assess the effect on population health followed by changes of health services. Disease- or symptom-specific health assessment is necessary to analyze general population health in more detail.

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Reference

Cutler, D. and Richardson, E. (1997), "Measuring the

Health of the U.S. Population", *Brookings Papers Microeconomics*, pp.217-271.

Drummond, M.F., O'Brien, B., Stoddart, G.L. and Torrance, G.W. (1986), "Methods for the Economic Evaluation of Health Care Programmes", *Oxford Medical Publications*

Groot, W. (2000), "Adaptation and Scale of Reference Bias in Self-Assessments of Quality of Life", *Journal of Health Economics* 19, pp.403-420.

Kenkel, D.S. (1995), "Should You Eat Breakfast? Estimates From Health Production Functions", *Health Economics* 4, pp.15-29.

Kerkhofs, M. and Lideboom, M. (1995), "Subjective Health Measures and State Dependent Reporting Errors", *Health Economics* 4, pp.221-235.

Torrance, G.W. (1986), "Measurement of Health State Utilities For Economic Appraisal A Review", *Journal of Health Economics* 5, pp.1-30.

Ubel, P.A., Richardson, J. and Menzel, P. (2000), "Societal Value, the person trade-off, and the dilemma of whose values to measure for cost-effectiveness analysis", *Health Economics* 9, pp.127-136.

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