Estimating the monetary value of health and capability well-being applying the well-being valuation approach

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Health economic evaluations

- Cost-utility analysis inform decisions about resource allocation in health care
- Utility is assessed through generic preference-based health instruments (e.g. EQ5D)
- Ratio of costs and health benefits of an intervention is compared to a certain cost-effectiveness threshold to assess cost-effectiveness
- QALY threshold is (partly) informed by a string of literature aiming to estimate the WTP for a QALY

Health (?) economic evaluations

- Recent interest in the questions whether maximising health is appropriate in all contexts of health care delivery
- Some interventions rather aim to improve well-being than restore health
- Especially relevant in areas like palliative and elderly care, mental health and integrated social care

Broader well-being

- Development of instruments with a broader focus than health
- Focus on operationalisations of the capability approach
- Approach emphasises individuals' ability to reach certain well-being states (capability) instead of being in them (functioning)
- ICECAP-A is one preference-based and validated capability well-being instrument

ICECAP-A

1. Feeling settled and secure

I am able to feel settled and secure in **all** areas of my life	4
I am able to feel settled and secure in **many** areas of my life	3
I am able to feel settled and secure in **a few** areas of my life	2
I am **unable** to feel settled and secure in **any** areas of my life	1

2. Love, friendship and support

I can have **a lot** of love, friendship and support	4
I can have **quite a lot** of love, friendship and support	3
I can have **a little** love, friendship and support	2
I **cannot** have **any** love, friendship and support	1

3. Being independent

I am able to be **completely** independent	4
I am able to be independent in **many** things	3
I am able to be independent in **a few** things	2
I am **unable** to be at all independent	1

ICECAP-A

4. Achievement and progress

I can achieve and progress in **all** aspects of my life	4
I can achieve and progress in **many** aspects of my life	3
I can achieve and progress in **a few** aspects of my life	2
I **cannot** achieve and progress in **any** aspects of my life	1

5. Enjoyment and pleasure

I can have **a lot** of enjoyment and pleasure	4
I can have **quite a lot** of enjoyment and pleasure	3
I can have **a little** enjoyment and pleasure	2
I **cannot** have **any** enjoyment and pleasure	1

Research objective

Our aim is to provide a first estimate of the monetary value for capability well-being
Approach:

1. Estimate a monetary value for capability well-being using the ICECAP-A
2. Repeat calcuations for health via the EQ5D-5L
3. Compare monetary values with each other and the existing literature for wQALY

Well-being valuation approach

- The idea of WV is to to calculate the impact of a non-market good and income on subjective well-being
- the marginal rate of substitution between the levels of income and the non-market good is then utilised to estimate a compensating welfare measure
- This compensating variation is the change in income necessary to hold individuals welfare or utility constant after imposing a certain change in a non-market good
- can be and was applied for many different non-market goods

Well-being valuation approach

Main assumptions:

1. Individuals utility or welfare is expressed by subjective well-being and determined in the following way:

$$u(Q,Y,X) = SWB(Q,Y,X) \tag{1}$$

2. Interpersonal comparability of SWB values

Well-being valuation approach

- Fujiwara (2013) and Dolan and Fujiwara (2016) propose a three-stage framework
- separate models allow to calculate the total impact of income or the non-market good
- Dolan and Fujiwara (2016) purpose to 'use statistical methods that get as close as possible to unbiased causal estimates'
- Fujiwara (2013) estimated the monetary equivalent value of unemployment in the UK general population

Three-stage well-being valuation approach

Stage one: Income model

$$SWB_i = f(\ln(Y_i)) \tag{2}$$

Stage two: Non-market good model

$$SWB_i = g(Q_i) \tag{3}$$

Stage three: Monetary equivalent value

$$CS = Y^0 - e^{\left[\ln(Y^0) - \frac{g'Q}{f'Y}\right]} \tag{4}$$

Empirical challenges

Causal estimates for g'Q and f'Y are required to produce valid monetary equivalent values, but difficult to obtain due to:

1. Reverse causal relationships between health/capability well-being, income, and SWB
2. Omitted variable bias e.g. working hours, time spend away from family

Empirical challenges

- Multiple studies found that the income coefficient in WV is downward biased by a factor of 2-10 if endogeneity was not accounted for
- this lead to widely overestimated monetary values in many WV studies
- size and direction of bias are not as clear for health and unknown for capability well-being

Our empirical specification therefore tries to account for endogeneity in the income model while assuming exogeneity in the health/capability model

Data

Cross-sectional online questionnaire administered in the UK in 2018 with 1,373 complete responses, representative for the adult, non-senior population including:

- subjective well-being measures Cantrils ladder (0 to 10) and SWLS (5 to 35) with the former being used as SWB proxy in the base case calculations
- EQ5D-5L and ICECAP-A
- socioeconomic characteristics including household income
- module about contents insurance

Empirical specification

Models for non-market goods health (H) and capability well-being (CW):

$$SWB_i = \beta_0 + \beta_1 H_i + \beta_2 \ln(Y_i) + \beta_3 X_i + \varepsilon_i \quad (5)$$

$$SWB_i = \alpha_0 + \alpha_1 CW_i + \alpha_2 \ln(Y_i) + \alpha_3 X_i + \mu_i \quad (6)$$

With X including variables selected in line with a review by Dolan et al. (2008) on the main determinants of well-being or life satisfaction such as:

- sample variables age, gender, education
- marital status and employment status
- religious affiliation
- 'personality proxies' religiosity and HRAS-SF

Empirical specification

- Endogeneity of income in VW is frequently addressed using IV
- Previously used instruments: financial worsening, lottery wins, parents education, nr. of days after tax day, intelligence
- best available candidate in dataset: existence of contents insurance (35% in sample)

2SLS approach to estimate the causal impact of income (Y) on SWB:

$$SWB_i = \gamma_0 + \gamma_1 H_i + \gamma_2 \ln(Y_i) + \gamma_3 X_i + \omega_i \quad (7)$$

$$\ln(Y_i) = \delta_0 + \delta_1 CI_i + \delta_2 X_i + v_i \quad (8)$$

With CI = 1 if houshold has contents insurance

Empirical specification

Relevance:

- CI more affordable with higher income
- income related to presence of more valuable items in household

Exclusion restriction:

- unlikely that having CI directly affects your happiness/SWB
- CI indicative for risk preference? Very weak correlation (r=0.14) to HRAS-SF
- effect through (financial) stability? Correlation to ICECAP dimension stability of -0.15

Empirical specification

- Cantrils ladder as dependent variable in the base case ranges from 0 to 10
- both linear and latent variable models like ordered probit could be used for estimation of equations (5) to (8)
- Ferrer-i-Carbonell and Frijters (2004) showed there is little differences in the trade-offs between variables using either model
- OLS is used for ease of computation and interpretation

Empirical specification

Calculation of compensating surplus (CS) or monetary equivalent values:

$$CS(QALY) = \frac{1}{\Delta H} * \left[Y^0 - e^{\left[\ln(Y^0) - \frac{\beta_1}{\gamma_2} * \Delta H \right]} \right] \tag{9}$$

$$CS(YFC) = \frac{1}{\Delta \mathrm{CW}} * \left[Y^0 - e^{\left[\ln(Y^0) - \frac{\alpha_1}{\gamma_2} * \Delta \mathrm{CW} \right]} \right] \tag{10}$$

with:

- ΔH and ΔCW set to 0.1, oriented on MID of EQ5D, and altered in robustness checks
- Y^0 represents median income level to obtain a population estimate

Regression output

Table 2: Regression results (shortened)

	(I) EQ5D		(II) ICECAP		(III) Income-IV	
Log yearly income	0.495***	(0.065)	0.308***	(0.054)	**2.201*** **	(0.638)
EQ5D	**2.665*** **	(0.305)			2.310***	(0.378)
ICECAP			**6.234*** **	(0.243)		
...						
N	1,373		1,373		1,373	
R-squared	0.334		0.564		-	
Kleibergen-Paap LM					21.55***	
Kleibergen-Paap Wald F					21.63***	
Endogeneity					10.65***	

Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Calculations of monetary values

$$CS(QALY) = \frac{1}{\Delta H} * \left[Y^0 - e^{\left[\ln(Y^0) - \frac{\beta_1}{\gamma_2} * \Delta H\right]} \right] = \frac{1}{0.10} * \left[£27{,}000 - e^{\left[\ln(£27{,}000) - \frac{2.665}{2.201} * 0.10\right]} \right] = £\,30{,}786 \quad (9)$$

$$CS(YFC) = \frac{1}{\Delta \mathrm{CW}} * \left[Y^0 - e^{\left[\ln(Y^0) - \frac{\alpha_1}{\gamma_2} * \Delta \mathrm{CW}\right]} \right] = \frac{1}{0.10} * \left[£27{,}000 - e^{\left[\ln(£27{,}000) - \frac{6.234}{2.201} * 0.10\right]} \right] = £\,66{,}597 \quad (10)$$

Robustness checks

Table 3: Base case and alternative specifications

	Base case	No IV	IV Fujiwara [a]	SWLS [b,c]	Sum scores [c]	Mean income	Increment 0.05	Increment 0.20
Coefficients								
log income	2.201	0.495	1.103[a]	2.633	2.255			
EQ5D	2.665	2.665	1.599[a]	2.131	2.858			
ICECAP	6.234	6.234	3.740[a]	7.488	5.881			
WTP in £								
1 QALY	30,786	112,336	36,431	20,988	32,141	43,149	31,717	29,031
1 YFC	66,597	193,305	77,651	66,828	61,979	93,343	71,305	58,384
rel. size	2.2	1.7	2.1	3.2	1.9	2.2	2.2	2.0

[a] Income coefficient from Fujiwara et al. (2013), other coefficients rescaled to match SWB in that analysis
[b] Rescaled from 0 to 10, [c] instrument passes under- and weak identification test with similar values as in the base case

Summary of results

- the chosen appraoch provided monetary valuations for QALY and YFC of GBP 30,786 and GBP 66,597
- relative size of monetary valuations somewhat consistent across model specifications
- Huang et al. (2018) using a similar approach found a value of 20,797 and 32,990 for 1 QALY and 55,130 for 'well-being' adjusted lifeyear

Limitations

- we had to assume exogeneity of health and capability well-being as no appropriate instruments were available
- deviate from original approach to capture total derivatives
- exclusion restriction for income instrument
- instrumented income coefficient reasonably close to analysis by Fujiwara (2013), who was able to use lottery wins (1.321 vs 1.103)
- interpretation of monetary values?

Take home message

1. If causal estimates of income and the non-market goods can be derived well-being valuation can be used to estimate the wQALY wYFC

2. Capability well-being is consistently valued higher than health by a factor of 2

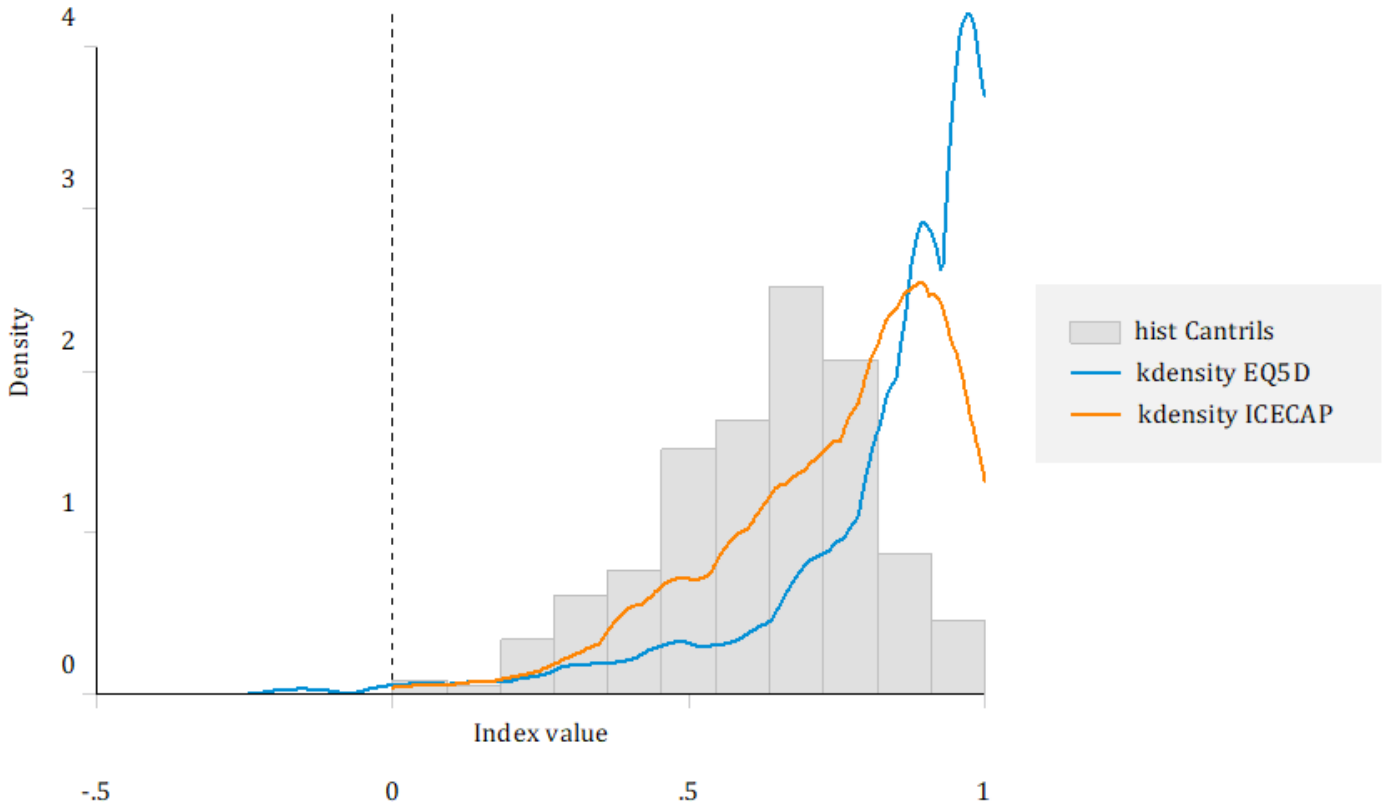
Descriptive statistics

Table 1: Descriptive statistics

	Mean	SD	Description
Cantrils ladder	6.4	2.0	0-10, 0 Worst possible life, 10 best possible life
SWLS	19.3	7.2	5-35, 5 least satisfied, 35 most satisfied
ICECAP	0.748	0.20	0-1, 0 no capabilities, 1 full capabilities
EQ5D	0.837	0.21	-0.242-1, 1 full health
HH income in £	37,848	56,724	per year before taxes, median 27,000
age	42.6	13.9	18-65, >65 not included in survey
female	0.518	-	0 no, 1 yes
Tertiary education	0.454	-	0 no, 1 yes, finished education after secondary school
Married	0.595	-	0 no, 1 yes
Divorced or widowed	0.092	-	0 no, 1 yes
Never married	0.313	-	0 no, 1 yes
Employed	0.548	-	0 no, 1 yes
Self-employed	0.095	-	0 no, 1 yes
Unemployed	0.055	-	0 no, 1 yes
Homemaker	0.097	-	0 no, 1 yes
Student	0.052	-	0 no, 1 yes
Retired	0.095	-	0 no, 1 yes
Unable to work	0.058	-	0 no, 1 yes
Christian	0.421	-	0 no, 1 yes
Atheist	0.328	-	0 no, 1 yes
Agnostic	0.130	-	0 no, 1 yes
Muslim	0.038	-	0 no, 1 yes
Other religion	0.084	-	0 no, 1 yes, e.g. Sikh, Jews, Hindu, Buddhist
Importance of religion	2.8	2.0	1-7, 1 not at all important, 7 very important
HRAS-SF*	29.0	5.8	6-42, 6 risk loving, 42 risk averse
N	1,373		

*Health Risk Attitude Scale Short Form

Descriptive statistics



Regression output

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Log yearly income	0.495***	(0.065)	0.308***	(0.054)	**2.201*** **	(0.638)
EQ5D	**2.665*** **	(0.305)			2.310***	(0.378)
ICECAP			**6.234*** **	(0.243)		
Age	-0.0264	(0.029)	-0.00586	(0.024)	-0.00363	(0.037)
age2	0.000293	(0.000)	0.000126	(0.000)	0.000086	(0.000)
male	-0.0107	(0.093)	-0.0122	(0.075)	-0.0683	(0.119)
Tertiary education	0.0378	(0.094)	-0.0854	(0.076)	-0.395*	(0.199)
Divorced or widowed	-0.358*	(0.168)	0.0784	(0.132)	0.256	(0.304)
Never married	-0.536***	(0.121)	-0.0325	(0.096)	0.202	(0.306)
Self-employed	0.100	(0.180)	0.117	(0.139)	0.451	(0.249)
Unemployed	-0.579*	(0.231)	-0.275	(0.190)	0.661	(0.546)
Homemaker	-0.257	(0.169)	-0.0279	(0.133)	0.387	(0.308)
Student	-0.357	(0.247)	-0.589**	(0.226)	-0.0836	(0.365)
Retired	0.537**	(0.188)	0.115	(0.148)	0.864***	(0.253)
Unable to work	-0.514	(0.277)	-0.541**	(0.197)	0.672	(0.534)
Atheist	0.245	(0.138)	0.182	(0.111)	0.268	(0.168)
Agnostic	0.0974	(0.161)	0.0953	(0.139)	0.0380	(0.202)
Muslim	-0.462	(0.303)	0.0131	(0.241)	-0.330	(0.307)
Other religion	-0.0132	(0.172)	0.101	(0.145)	-0.0948	(0.235)
Importance of religion	0.147***	(0.031)	0.0972***	(0.025)	0.148***	(0.038)
HRAS-SF	0.0768***	(0.009)	0.0332***	(0.007)	0.0687***	(0.011)
Constant	-2.858**	(0.954)	-2.657***	(0.767)	-20.60**	(6.687)
N	1,373		1,373		1,373	
R-squared	0.334		0.564		-	
Kleibergen-Paap LM					21.55***	
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