Valuing the Health Impacts of Chemicals – ECHE

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Scope Sensitivity Tests in CV and DCE: An Application using WTP for Mortality and Morbidity Risk Reductions

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Background – Policy and (e)valuation

- W/o market failures no need for intervention - individuals' decision would maximize social welfare
  - Obvious market failure for health risks:
    - Non-informed individuals
    - Safety a "public good"

- Benefit cost analysis (BCA) a strong tool to guide resource allocation (legislation, investments, etc.)

- Common metric for benefits and costs – monetary values
  - Monetary values should reflect individual preferences!
  - Many benefits and costs do not have easily available prices $\Rightarrow$ non-market evaluation techniques…

Background – Risk evaluation

- Until recently two elicitation techniques have dominated eliciting preferences for "safety"
  - Hedonic pricing
    - Revealed preferences
    - Wage-risk studies
    - North America
  - Contingent valuation
    - Stated preferences
    - Large variation in risks and contexts
    - Europe and developing countries
- Recently choice experiments (DCE) have gained ground
  - Stated preferences
  - Rich on information, less prone to strategic bias, better description of (some) choice scenarios, etc
  - Demanding for respondents

Background – Empirical findings

- Most empirical estimates of the MWTP to reduce mortalilty risk fall within the range USD 1 to 10 million
  - Reliable estimates?
  - Publication bias?

- An area where many studies have been conducted is transport
  - Some RP but mainly SP studies
  - In Sweden more than 12 studies have been conducted (Hultkrantz and Svensson, HP, 2012)
    - Range: SEK 9 to 98 million (USD 1 = SEK 6.6)
    - Mean and median: SEK 34.6 and 23 million

Background – Scope sensitivity

- Evidence suggests that respondents have difficulties understanding small probabilites $\Rightarrow$ risk evaluation difficult
  - Scope/scale insensitivity a common problem in SP studies
- Well-established finding in the CV literature (e.g. Hammitt and Graham, JRU, 1999)
- Results from DCE suggest scope sensitivity
- CV results more scrutinized?

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Aim and objectives

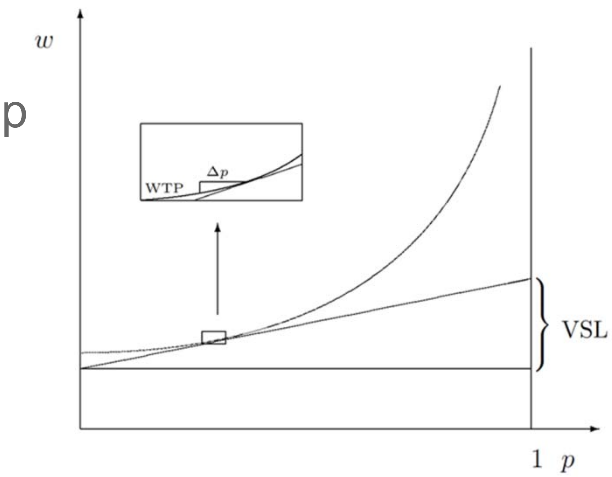
- The aim of this study is to elicit individual preferences to reduce the risk related to an infectious disease cause by the bacteria campylobacter: campylobacteriosis.

- The Specific objectives are to examine:

  - What is the WTP to reduce mortality and morbidity risks due to campylobacteriosis, and the associated Value of Statistical Life (VSL) and Illness (VSI)?
  - Do the welfare estimates differ depending on whether using a DCE or CV valuation task?
  - Do the DCE and CV designs show adequate sensitivity to scope?

Theory: Graphical illustration of VSC (VSL)

- Given standard assumptions:
  - VSC is positive and increasing with w and p
- VSC is the:
  - Mortality: value of a statistical life (VSL)
  - Illness: value of a statistical illness (VSI)



- For small baseline risk levels and small changes in p WTP is ”nearly proportional” to a change in p
- VSC is for finite changes in p given by
  - $VSC \approx \frac{WTP}{\Delta p}$
  - $\Rightarrow WTP \approx VSC \times \Delta p$
- Proof based on combination of theoretical model and empirical evidence of income elasticity of WTP (see, e.g., Hammitt, AERE, 2000)

Survey: General info

- Survey conducted in Sweden (Spring of 2012)
- Pretesting:
  - Focus groups
  - 2 pilots
- Web survey (Scandinfo)
- Survey structure
  - Warm-up: Questions related to risk
  - Campylobacteriosis and health: Info and self-perceived health
  - WTP-scenario: CE **or** CV section (diff. for diff. subsamples)
  - Background: Demographics and socio-economics
  - Follow-up questions: “How respondents answered survey”
- WTP to reduce health risks
  - Respondents informed that the social insurance system would cover financial losses and health costs if becoming ill

Subsamples and background information

- 2x2 (main) subsamples where SP method and mortality risk differ
  - DCE_A: Actual risk levels (n = 1000)
  - DCE_B: Levels of road mortality risk (n = 250)
  - CV_A: Actual risk levels (n = 500)
  - CV_B: Levels of road mortality risk (n = 200)
- Risk levels:
  - Illness: 63 000 cases per year in Sweden
  - Mortality:
    - A: Less than 5 cases per year
    - B: No “number” presented
- Distribution of illness
  - Mild: 77%, Moderate: 22%, Severe: 1%

DCE: WTP scenario (freely translated from Swedish)

- "[A]ssume that a government authority is considering two different policies that can reduce the occurrence of campylobacter; a stricter food control or improved water sanitation. We are interested in your valuations of these policies and will now ask you to answer 8 different questions. Apart from the fact that the policies differ with respect to the focus on food or water-spread campylobacter, the policies also differ regarding: the number of fewer deaths, the number of fewer illnesses, when the policy starts to have a beneficial effect and the cost of the policy."

CV: WTP scenario (freely translated from Swedish)

- "[A]ssume that a government authority is considering two different policies that can reduce the occurrence of campylobacter; a stricter food control or improved water sanitation. We are interested in your valuations of these policies and will now ask you to answer 4 different questions. Apart from the fact that the policies differ with respect to the focus on food or water-spread campylobacter, the policies also differ regarding: the number of fewer deaths, the number of fewer illnesses, when the policy starts to have a beneficial effect and the cost of the policy."

Attributes and their levels

Attribute	**Variable name**	**Attribute levels**		**Anticipated sign**
Source of disease	*water*	Water = 1 (Food = 0)		**0/+**
Mortality reduction	*die*	**Sample A**	**Sample B**	**+**
		1	100	
		2	200	
		4	400	
Morbidity reduction	*sick*	8 000, 16 000, 32 000		**+**
Delay (years)	*delay*	No delay, 2, 5, 10		**- (transf. $\Rightarrow$ +)**
Cost (SEK)	*cost*	500, 1 000, 2 000		**-**

Choice set (freely translated from Swedish)

What do you prefer in this situation?

	Policy A	**Policy B**
Source of disease	Water	Food
Number of fewer individuals who die (per year) when the policy is implemented	1	2
Number of fewer individuals who get sick (per year) when the policy is implemented	16 000	8 000
The policy starts to have effect	this year	in 10 years
Your cost (per year)	1 000 SEK	2 000 SEK

I prefer

☐ Policy A

☐ Policy B

☐ None of the suggested policies (today’s situation remains and no additional cost for you)

Choice sets

- D-optimal design $\Rightarrow$ 64 choice set $\Rightarrow$ blocked into 8 versions

- Thus, respondents asked to answer 8 choice sets

- Possibility to "change their mind" after 1st choice set (16.8% changed their mind)
  - Used instead of "risk-dollar training session"
    - Training session fairly easy to include in some other SP techniques, such as the contingent valuation method, but we felt that it would only add confusion to this study

Contingent valuation

- Open-ended format used:
  - Avoid anchoring effects
  - Contrast with the DCE where the analyst sets the levels, i.e. here the respondent can state any number
    - Mitigate the risk that our design “drives the results”
- WTP question
  - “What is the maximum amount that you would be willing to pay per year during a five year period for a stricter [food, water] sanitation that would imply that [1, 2, 4; 100, 200, 400] fewer persons per year will die [or become sick] due to campylobacteriosis?”
- Each respondent answered 4 questions (Food/Water and Mortality/Morbidity) in randomized order – Only first answer used in analysis
- Same risk levels used as in DCE

Empirical models

- DCE: Conditional logit based on

$$U_{njt} = sq + \beta_1 die_{njt}\exp(-\delta delay_{njt}) + \beta_2 sick_{njt}\exp(-\delta delay_{njt}) + \beta_3 water_{njt} + \beta_4 cost_{njt} + \varepsilon_{njt}$$

- where $\beta_0,\ldots,\beta_5$ are coefficients to be estimated, sq_{njt} is an ASC for the status quo alternative and ε_{njt} is a random error term which is assumed to be IID type I extreme value
- Marginal WTP: $-\dfrac{\partial U_{njt} / \partial die_{njt}}{\partial U_{njt} / \partial cost_{njt}} = -\dfrac{\beta_1}{\beta_4}$
- CV: Open-ended WTP $\Rightarrow$ WTP regression

$$\ln(WTP_s) = \beta_0 + \beta_1 \ln(\Delta p_s) + \sum_k \beta_k x_k + \varepsilon$$

- CV analysis preliminary!

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Descriptive statistics: ”Background vars”

- Samples well representative of the general population
- Risk perception and experience similar between samples
- No differences between samples (levels and stat. sign.)
- See paper for details

Regression analysis: Clogit (DCE)

Table 3 Conditinal logit estimates sample DCE_A and DCE_B

	$\mathbf{DCE_A}$	$\mathbf{DCE_B}$
sq	0.0966 (1.16)	0.00754 (0.04)
water	0.235*** (6.23)	0.237*** (3.19)
sick	0.0000309*** (13.43)	0.0000243*** (5.58)
die	0.298*** (16.79)	0.00344*** (9.84)
cost	-0.000566*** (-15.97)	-0.000442*** (-6.56)
delay	0.101*** (12.31)	0.0919*** (5.86)

Regression analysis: WTP reg (CV)

Table 4 CV Regression coefficient estimates (robust std.err): dep. variable is Ln(WTP)

	Mortality risk reductions			Morbidity risk reductions	
	CV_A	CV_B	CV_A and CV_B	CV_A	CV_B
constant	4.79***	5.54***	4.85	5.75*	11.63***
	(0.29)	(1.44)	(0.25)	(2.57)	(3.71)
Ln(risk reduction)	0.82***	0.01	0.61***	-0.08	-0.66
	(0.25)	(0.26)	(0.20)	(0.26)	(0.38)
CV_B	-	-	-2.29**	-	-
			(0.92)		
water	-0.69**	-0.12	-0.54	0.18	-0.30
	(0.29)	(0.34)	(0.23)	(0.31)	(0.43)

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Regression analysis: Individual characteristics

- Conditional logit also run with interactions:
  - Age (groups: <35, 35-55, 55+)
  - Income (less/more SEK 30000 per month)

- Most interactions statistically insignificant
  - Few exceptions
  - No “trends”

- CV WTP regressions and ind. characteristics:
  - Wealth positive and statistically significant in CV_A
  - Age never statistically significant

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VSL and VSI

		CE		CVM
		Clogit	Latent*	
VSL (MSEK)	Sample A	4732	4636	3522
	Sample B	70	69	35
VSI (kSEK)	Sample A	490	560	0.44
	Sample B	490	570	0.59

- (USD 1 = SEK 6.57, EUR 1 ≈ SEK 9)
- * Andersson, Hole, and Svensson (JEEM, 2016)
- Values for Food
- Swedish review of VSL in Transport:
  - Range: SEK 9 to 98 million
  - Mean and median: SEK 34.6 and 23 million

Discussion/Conclusions (I)

- VSL and VSI for reducing risk of campylobacteriosis estimated for Sweden using DCE and CV
- DCE: Regression results in line with expectations:
  - Water preferred to food policies
  - Policy with benefits “now” rather than “later” preferred
  - Larger risk reduction preferred
  - Policies with lower cost preferred
- CV: Regression results mixed – Scope sensitivity in some but not all regressions
  - WTP on accurate mortality risk levels (CV_A) cannot be rejected to be proportional to Δp
- VSL comparison between DCE and CV reveals similar findings
  - WTP not sensitive to the difference in size between subsamples
  - Do respondents have an amount they are willing to forgo for ”any risk reduction” (e.g. 70 €)?

Discussion/Conclusions (II)

- When risk levels from road transport used $\Rightarrow$ VSL in line with Swedish estimated for road safety
  - Validity and reliability of Swedish "Road ASEK VSL"?
  - Validity and reliability VSC in general?
- Visual aids not used in survey
  - Accurate baseline risk very small (< 5 in a million)
  - No specified number for the baseline risk in subsamples "B", since dp>true baseline risk
  - Efforts were taken to make sure respondents understood the risk-dollar tradeoff (verbal probability analog, feedback)
- Baseline risk is extremely small
  - What if larger risks were examined?