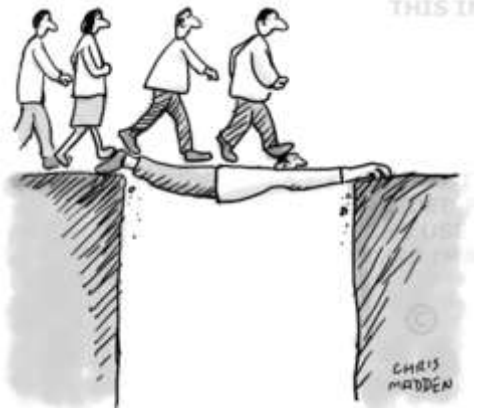
International Institute for Carbon-Neutral Energy Research

Estimation of altruistic benefits of GHG emission reduction for low carbon technology evaluation

Kenshi Itaoka



November 4, 2019

The 4th European Technology Assessment Conference

KYUSHU UNIVERSITY

wpi World Premier International Research Center Initiative

ILLINOIS UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Contents

- Objective
- Survey design
- Result
- Discussion
- Conclusion

Background

- When quantifying the GHG emission reduction benefit to compare the cost in policy analyses, usually some value of Social Cost of Carbon (SCC) is equated.
- SCCs have been calculated by aggregation of various monetized damages of climate change in various fields or by assuming damage functions by many researchers.
- Human health damage consist in a large part of SCC and traditional Value of Statistical Life (VSL) is used to monetize benefit of avoid human health damage (mainly mortality risk increase) of climate change.
- VSL is estimated based on the question “how much would you like to pay to reduce your own mortality risk” . Therefore, there is not much room that SCC reflect altruistic benefits people can appreciate.
- **The large part to benefit (avoidance of damage) of low carbon technology implementation will happen in the future generation and /or in different countries from the county where the technology is used in spite that emission is reduced in the current generation and the cost of low carbon energy technologies is paid by current generation.**

Objective

- To estimate altruistic benefits of low carbon technologies in money term.
- To estimate WTP (willingness to pay) for altruistic benefits of policies to low carbon implement technologies.

SURVEY DESIGN

Survey implementation

- Survey area: 3 countries; Japan, U.S and Indonesia
- Survey period：2019 January –March
- Sample size: 1000 for each country (total 3000)
- Method: Internet survey (PC, smart phone)

- Analytical model for choice experiments: randam parameter logit model (mixed logit model)

Questionnaire design

- Regular questions asking environmental concern, awareness and behavior
  + two sets of choice experiments

- Choice experiment design
  - Introduction: hypothetical global climate policies coordinated by UN
  - Information provision:
    - Effect of the portfolios of measures against climate change (damages of climate change)
    - Types of measures against climate change
  - Format: status quo + two policy portfolio alternatives
  - Two types of questions: 4 choice questions x 2 sets

Introduction of choice experiment

- Climate change is a global issue, and various countries around the world and the UN in particular are taking measures against it. Going forward, it is anticipated that both developed countries and developing countries will cooperate in terms of funding and technology to take measures against climate change as indicated in the Paris Agreement (2015).

- Please imagine that portfolios of measures against climate change which will have the effect calculated below are being examined for the future against this background.

- The portfolios of measures against climate change will reduce the damage caused by climate change in various areas. The concrete effect of the measures has been estimated with respect to the following three kinds of damage: Human health damage, property damage and ecological damage.

Information provision

- **Effect of the portfolios of measures against climate change (damages of climate change)**

Table: Effect of the portfolios of measures against climate change (Areas in which the impact of climate change is reduced)

Type of damage		Specific content of the damage
Reduction of human health damage		- Effects from rises in temperature such as heat waves - Effects from increased frequency and severity of typhoons and heavy rain - Effects from floods and storm surges, etc. - Infections from animal vectors (such as mosquitos) - Starvation
Reduction of property damage		- Loss of land due to rising sea levels - Damage to agricultural products - Increased use of energy due to greater cooling demands
Reduction of ecological damage		- Decrease in biodiversity - Decrease in precious species - Decrease in creatures that are key to ecosystems such as coral reefs

Information provision 2

● Types of measures against climate change

- Portfolios of measures against climate change which combine measures to inhibit the emission of greenhouse gases such as carbon dioxide (Mitigation (emission reduction) measures) and measures to control the effects of climate change such as the construction of levees (Adaptation measures) are being considered.

Table: Types of measures against climate change

Mitigation (emission reduction) measures	Adaptation measures
	
- Energy saving - Improvement of energy efficiency - Promotion of natural energy - Promotion of carbon-dioxide capture and storage technology - Promotion of nuclear power, etc.	- Construction of levees - Promotion of installation of the air conditioner - Improvements to public health - Extermination / prevention of increase in mosquitoes - Promotion of the thermal insulation of buildings - Improvement to crop varieties, etc.
A damage reduction effect is seen worldwide	A damage reduction effect is seen primarily in those countries and regions implementing the measures

Portfolio of measures
- A combination of mitigation (emission reduction) measures and adaptation measures - Implemented through taxes - The timing of the effects and regions in which the effects are seen will differ depending on the portfolio

Choice question 1

Q18 So then, how about measure portfolio I and measure portfolio J?
Do you support increased taxes to implement these measure portfolios?
You can also choose to support no measures in which case there will be no tax increase.
Please select one option to support.

Type of damage	Location	Period of the damage	No measures	Measure portfolio I	Measure portfolio J
			Amount of damage	Amount of damage (Reduction of damage)	Amount of damage (Reduction of damage)
Human health damage (Annual deaths)	Your country	Annually from now until 2050 (per 100,000 people)	5 people	people (Reduction of 5 deaths)	people (Reduction of 5 deaths)
		Annually from 2050 to 2100 (per 100,000 people)	14 people	people (Reduction of 14 deaths)	people (Reduction of 14 deaths)
	Other countries	Annually from now until 2050 (per 100,000 people)	10 people	people (Reduction of 10 deaths)	people (Reduction of 10 deaths)
		Annually from 2050 to 2100 (per 100,000 people)	28 people	people (Reduction of 28 deaths)	people (Reduction of 28 deaths)
Annual tax burden per household		Annually from now on	$0	$ hundred	$ hundred
		Please select one option to support.	○	◉	○

Choice question 2

Q14 Do you support increased taxes to implement measure portfolio A or measure portfolio B described below?
You can also choose to support no measures in which case there will be no tax increase.
Please select one option to support.

Type of damage	Period of the damage	No measures	Measure portfolio A	Measure portfolio B
		Amount of damage	Amount of damage (Reduction of damage)	Amount of damage (Reduction of damage)
Human health damage (Annual deaths)	Annually from now until 2050 (per 100,000 people)	8 people	people (Reduction of 8 deaths)	people (Reduction of 8 deaths)
	Annually from 2050 to 2100 (per 100,000 people)	24 people	people (Reduction of 24 deaths)	people (Reduction of 24 deaths)
Property damage (Annual property damage)	Annually from now until 2050	3.0% of GDP	% of GDP (Reduction of 3.0%)	% of GDP (Reduction of 3.0%)
	Annually from 2050 to 2100	7.5% of GDP	% of GDP (Reduction of 7.5%)	% of GDP (Reduction of 7.5%)
Ecological damage (Long-term species extinction)	Gradually between now and 2100 (Proportion of extinction amongst 80,000 species of flora and fauna in regions of high importance for global conservation*)	50% extinction	% extinction (Reduction of 50%)	% extinction (Reduction of 50%)
Annual tax burden per household	Annually from now on	$0	$ hundred	$ hundred
	Please select one option to support.	○	○	○

* 35 regions rich in biodiversity such as the South American Amazon and Galapagos Islands, Madagascar (Africa), the Amur river basin in f
eastern Russia and the Arctic Ocean, etc.

RESULTS

WTP estimation for choice experiment 1

Unit: US$(2018)

Type of reduced damage	Location	Period of the damage	unit	Japan		U.S.		Indonesia		All countries	
ASC for anti-climate measures				356	***	1,244	*	3,566	***	1,256	***
Human health damage (annual deaths/1000000)	Your country	from now until 2050	death /10^6	-		*50*	**	*43*	***	*27*	***
		from 2050 to 2100	death /10^6	-		39	***	19	***	18	***
	Other countries	from now until 2050	death /10^6	11	**	31	**	13	*	16	***
		from 2050 to 2100	death /10^6	12	***	30	***	23	***	20	***

*10% significance level, **5% significance level, ***1% significance level

WTP estimation for choice experiment 2

Unit: US$(2018)

Type of reduced damage	Period of the damage	unit	Japan		U.S.		Indonesia		All countries	
ASC for anti-climate measures			758	***	-1,230	*	2,280	***	481	*
Human health damage	from now until 2050	death /10^6	15	**	-		-		-	
(annual deaths/1000000)	from 2050 to 2100	death /10^6	-		91	***	24	**	24	***
Property damage	from now until 2050	%GDP	-		-		-		-	
(annual property damage)	from 2050 to 2100	%GDP	41	***	178	*	-		40	**
Ecological damage (Long-term species extinction)	Gradually between now and 2100	%	-		85	***	27	***	22	***

*10% significance level, **5% significance level, ***1% significance level

Discussion

- People will support implementation of anti-climate measures mainly or partially with altruistic reasons.
- Japanese and Indonesian respondents showed significant ASC for anti-climate policy portfolio, which is interpreted as a donation for climate policy.
- High income of Indonesian respondents by skewed sampling influenced evaluation.
- Mortality risk reduction in other countries matters in respondents in the three courtiers.
- Japanese respondent did not care their mortality risk reduction but that of other courtiers.
- Respondents showed similar values for mortality risk reduction both of current generation and future generation in other countries.

Discussion 2

- U.S. respondents and Indonesian respondents discounted the mortality risk reduction of future generation if discount theory is applicable.
- Implied VSL is one order magnitude larger than the current VSL used in OECD countries of policy evaluation assuming the number of payers and beneficiaries are the same.
- U.S. respondents and Indonesian respondents did not show preference for mortality risk reduction of current generation but for that of future generation.
- Japanese respondents did not show preference for property damage risk reduction of current generation but for that of future generation.

Discussion 3

- Mitigation policies can be evaluated higher than adaptation policies because adaptation policy have less altruistic benefits.
- Benefits of implementation of low carbon technologies can be evaluated higher than the previous ones by considering:
  - Altruistic benefits
  - VSL based on societal preference.
- Use of very low discount rate can be justified in the climate policy context considering altruistic benefits.
- International cooperation (transferring fund from developed countries to developing) can be more justified from developed countries' view points considering altruistic benefits.