Decoding Carbon Tax Aversion: Investigating Pessimistic Beliefs and Willingness to Pay

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Motivation

- The vast majority of economists believe that a substantial **carbon price is necessary** to combat climate change, yet it **remains unpopular** (Tirole et al., 2023)

- **Tax & Dividend schemes** have often been proposed as a politically viable method for implementing a meaningful carbon price
  - Tax & Dividend equally **redistributes the revenue to all,** thus making it **progressive** and feasible to gain **the support of majority**
  - It has been supported by more than 3,000 economists (Economists' Statement on Carbon Dividends, The WSJ, 2019)
  - In Korea, some politicians have proposed implementing carbon pricing with the revenue being used for basic income programs

Motivation

- However, it remains uncertain whether a Tax & Dividend scheme would receive public support in Korea.
  - Recent studies have shown **limited impacts of carbon tax rebate programs** in Canada and Switzerland **on public support** for carbon taxes (Mildenberger et al., 2022)
  - **Biased beliefs** regarding the effects of a tax & dividend policy can lead to unjustified rejection (Douenne and Fabre, 2022)

Research Questions

- This paper largely consist of two parts

- **Q1)** Is a Tax & Dividend empirically progressive and able to gain the support of majority?: Objective **prediction** vs. *Subjective* ***perception***

- **Q2)** Practically, what is the acceptable level of carbon price and the most preferred design of carbon price?
  - Measuring **willingness to pay** for carbon pricing and **preference** for various policy designs

Methodology

- **Q1)** Is a Tax & Dividend empirically progressive and able to gain the support of majority?: Objective **prediction** vs. *Subjective* ***perception***
  - Assumed a **Tax & Dividend policy** that **collects 6만₩/tCO_2** and **pays out annually 11만원 per person (** 6만₩/tCO_2 ≈ 126₩/L gasoline)
- Used an **official survey** (NaSTaB from KIPF, 재정패널) to **simulate** ①**objective (personal) net gain**, ②**progressivity,** and ③**environmental effects (emission reduction)** of the Tax & Dividend policy
- Subsequently, conducted a representative survey to **collect perceptions** of the Tax & dividend policy and **compare** the responses to the simulation results

Methodology

- **Q2)** Practically, what is the acceptable level of carbon price and the most preferred design of carbon price?
  - Measuring **willingness to pay** for carbon pricing and **preference** for various policy designs

- It is **challenging** to find **actual data** to quantitatively measure **environmental policy preferences**

- Used **several stated preference methods** to elicit preferences over various carbon pricing policies
  - Choice experiment(CE) and **two variants** of contingent valuation methods(CVM) were used
    - **Convergent validity** of these methodologies discussed

Preview of the results

- **Q1)** Is a Tax & Dividend empirically progressive and able to gain the support of majority?: Objective **prediction** vs. *Subjective* ***perception***
  - collects 6만원/tCO2 and pays out 11만원 per person annually

- **Overall public support:** 77.6% expected financial gains, while 39.6% in favor and 37.4% opposed

- **Substantial pessimistic perception found**

	Expected	Perception
Monetary gain	An average gain of 8.9만원	loss of 9.6만원 22.8% predict gains and 52.8% losses
Progressivity	All but the top 10% would benefit	31.7% believe it progressive, while 50.6% perceived it as regressive
Environmental	3.6% reduction in emissions	32.4% pessimistically view, 49.3% believe it effective

Preview of the results

- **Q2)** Practically, what is the acceptable level of carbon price and the most preferred design of carbon price?

- **Willingness to pay** estimates by methodology**: convergent externality fails**
  - Reveals **limitations of stated preference methods**
  - Choice Experiments(CE): ₩25,300 - ₩59,200/ton
  - Contingent Valuation Method(CVM):
    - (Payment card methods) ₩16,400 - ₩17,400/ton
    - (Referendum experiments) ₩4,600 – ₩5,400/ton

- **Qualitative results remain consistent across all methodologies**
  - **Relative preference**: e.g.) income tax cut ≻ corporate tax cut
  - At higher carbon price, price becomes the decisive factor on approval

Related literature and Contributions

Carbon tax aversion

- Carattini et al.(2018), Klenert et al.(2018), van der Ploeg(2022) and many
- Economic interest – Thalmann(2004), Carattini et al.(2017), Spash and Lo (2012)
- Regressivity – Saelen and Kallbekken(2011), Baranzini and Carattinit(2017)
- Environment effectiveness – Klok et al.(2006), Kallbekken and Aasen (2010)

→ Investigated three key factors for carbon tax aversion in a unified setting

Pessimistic belief

- Millner and Ollivier(2016), Douenne and Fabre(2022)

→ Confirmed biases in perceptions

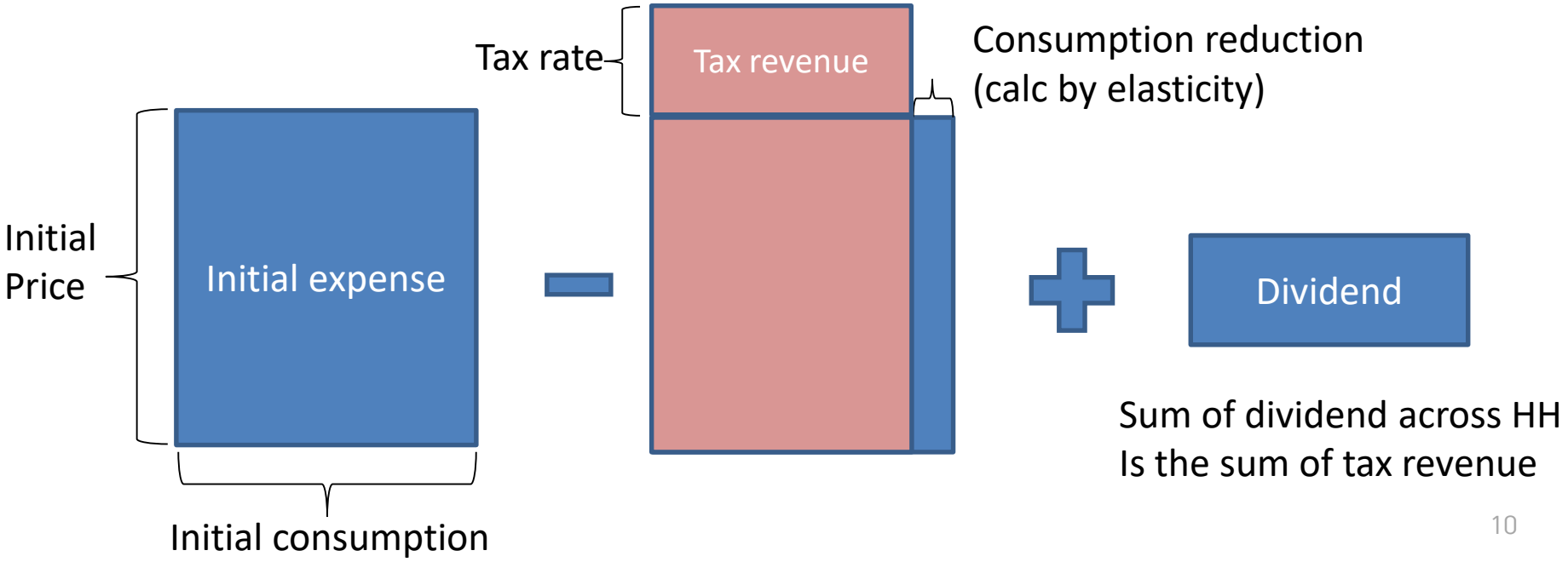
Convergent validity

- Hasler et al.(2005), Christie and Azevedo (2009), He et al. (2017) and many

→ First to test convergent validity in carbon pricing context

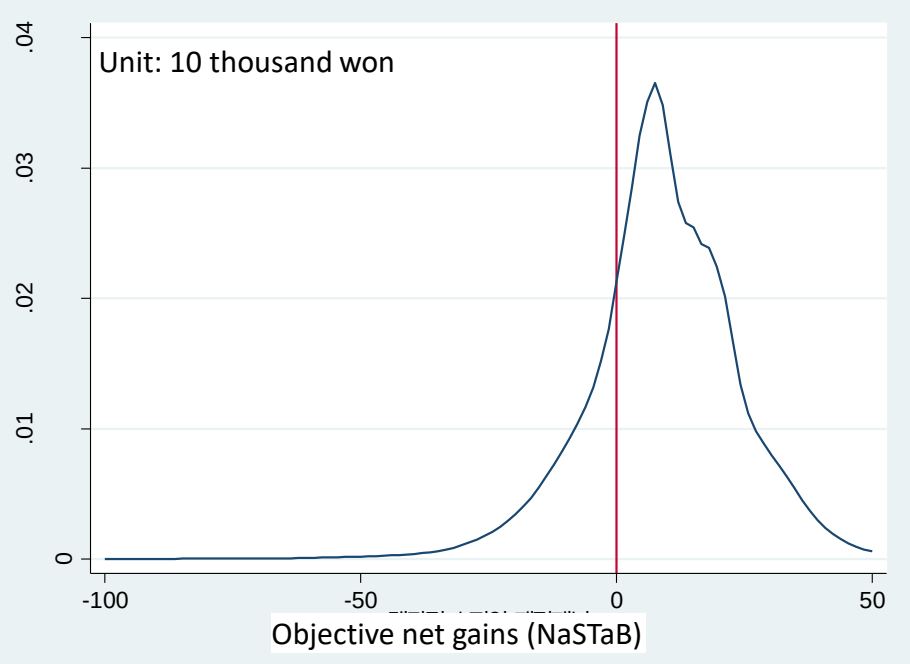
Part1 – Simulating the effects of Tax & Dividend

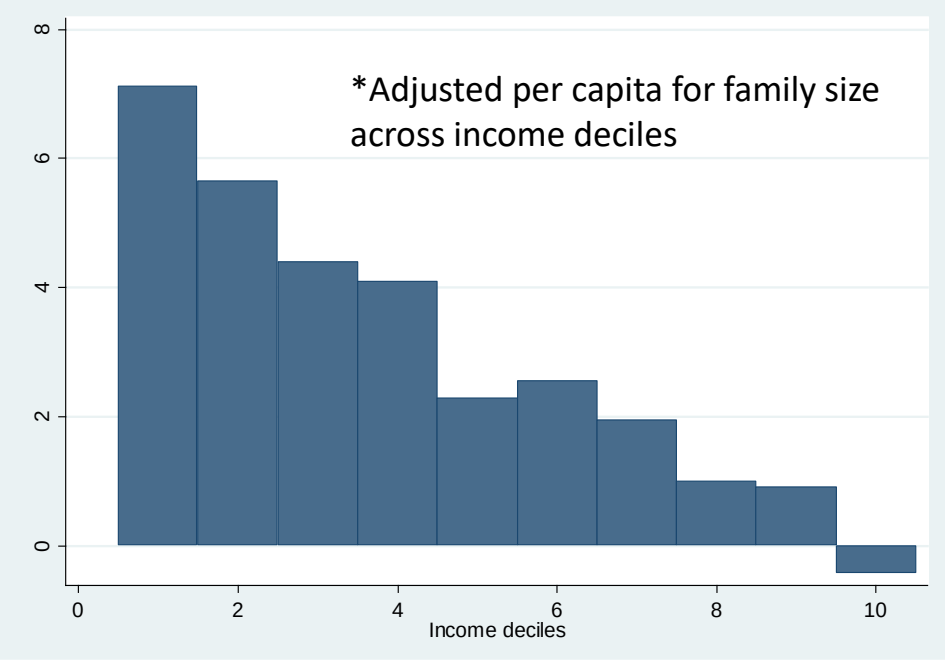
- Collect **expenses** and **quantity consumed** for energy products **for HH**
  - Gasoline, Diesel, Natural gas, Heating oil from NaSTab(재정패널, 8792 obs.)
- Simulated **objective net gains** for **each households**
  - Dividend – Increased expense (as in Douenne and Fabre,2022)
  - Levy 6만원/tCO_2 and pays out 11만원 per person annually



Part1 – Simulating the effects of Tax & Dividend

- Simulation Results
  - **77.6%** of households are expected to experience **a positive net gain**
  - The policy is **progressive**: all income deciles benefit except for the 10th
  - **Emission reduction by 3.6%** due to decreased consumption





An expected gain of 89,000 won per HH

Part1 – Perception collected in a representative survey

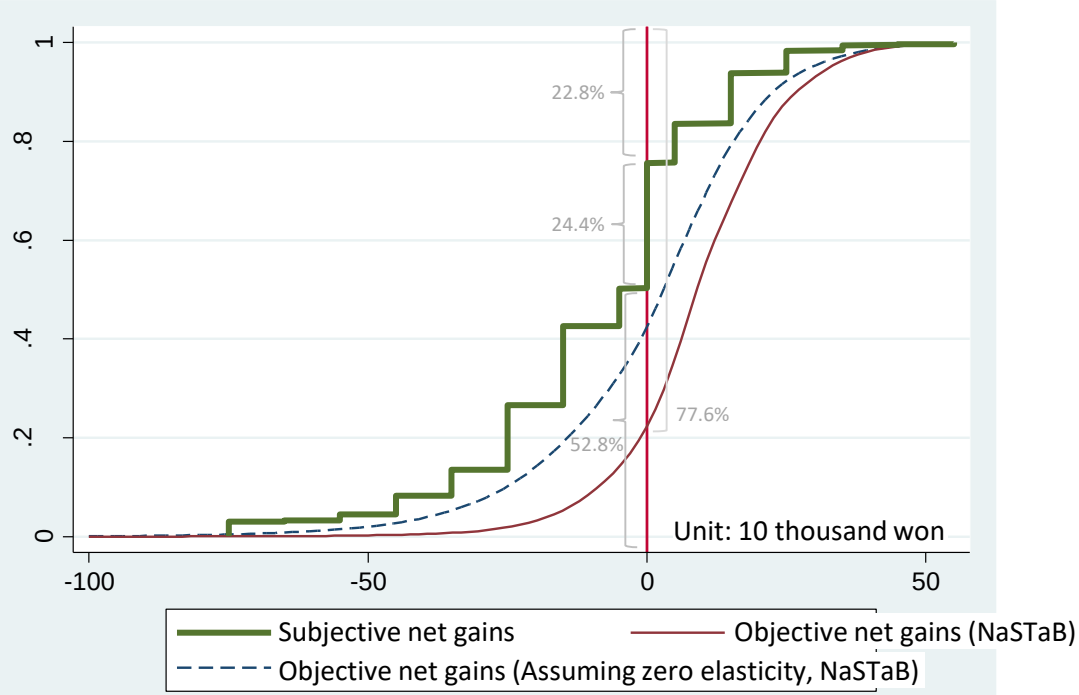
- **Gathered opinions** on the same Tax & Dividend policy (1191 obs.)
  - A 6만₩/tCO_2 and 11만₩ annual rebate per person
  - The survey questionnaires included
    - **Subjective net gain** (Win, Lose, or No change / Specify the amount within predefined intervals of 100,000₩)
    - Evaluation of the policy's **progressiveness**
    - Assessment of the policy's **environmental effectiveness** in combating climate change
    - Whether respondents would **approve** the policy
    - Percentage **reduction** in fossil fuel **consumption**

- Additional data collected
  - Age, gender, income, education, professions, political leaning, current expenses for energy products

Part1 – Biased belief in financial gains

- Subjects generally hold a pessimistic view of the policy's economic impact

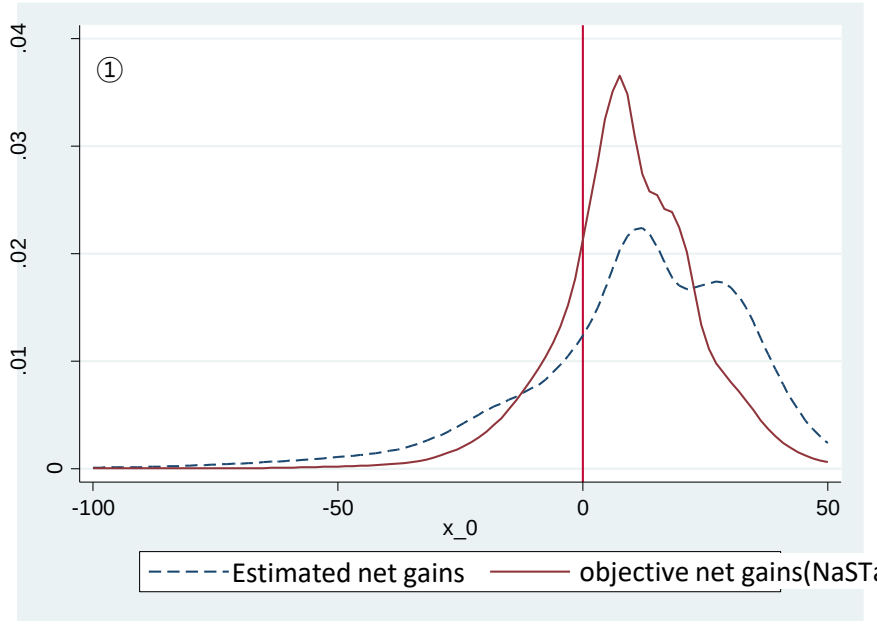
Cumulative Density Function of Net Gains

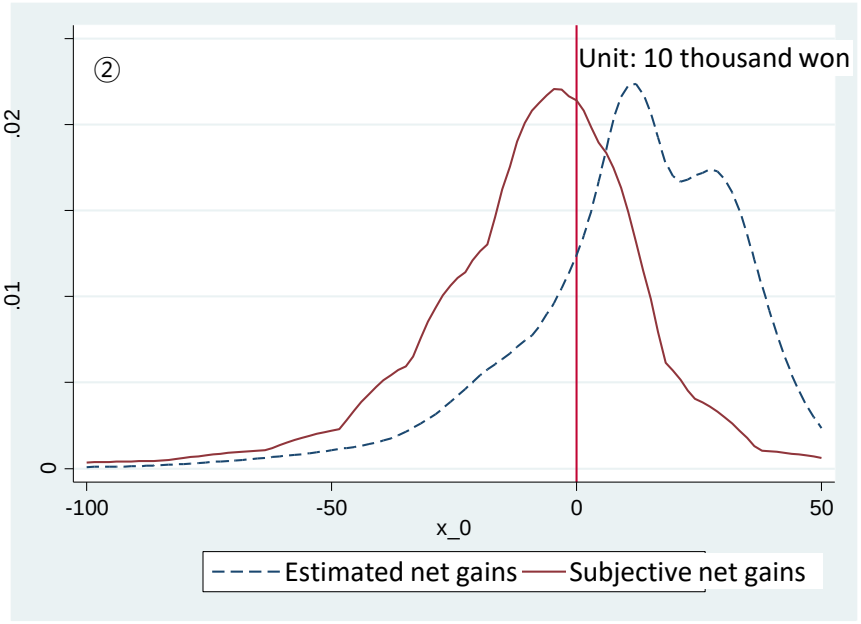


- Objectively, 77.6% expected to win, but **only 22.8% think they would** (52.8%-lose, 24.4%-DK/PNA)
- If consumers **do not adjust** their consumption(zero elasticity), they will **face greater expenses** from the carbon tax; however respondents perceive the policy's cost to be **even higher**
- This results are **similar** to a survey conducted in France(Douenne and Fabre, 2022)

Part1 – Biased belief in financial gains

- To delve into the biases of respondents, I measured **each individual's bias**
  - NaSTaB and the perception survey does not match individual level
  - ① Estimated net gains using expenses and individual elasticities in the **perception survey**
    - Estimated net gains are **comparable** to the objective net gains(NaSTaB)
  - ② Measure biases by differentiating the estimated net gains and subjective net gains





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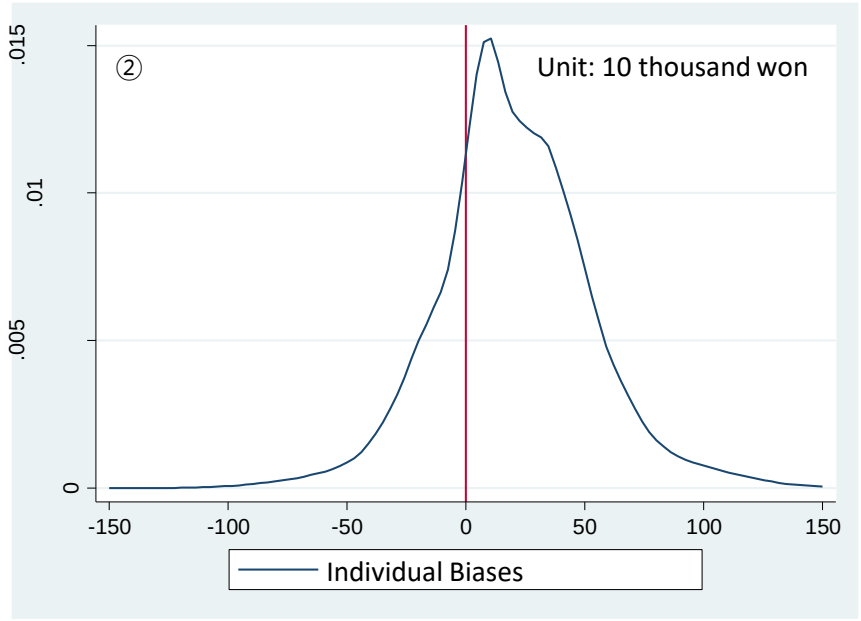
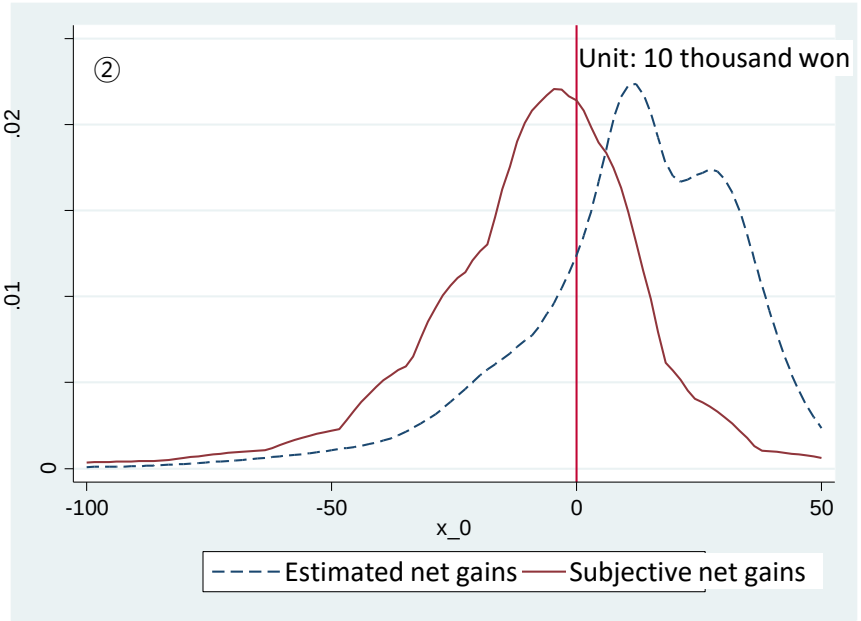
  - NaSTaB and the perception survey <u>does not match individual level</u>
  - ① Estimated net gains using expenses and individual elasticities in the perception survey
  - ② Measure biases by differentiating the estimated net gains and subjective net gains
    - **76.9% overestimated** private cost, and **median gap is 185,000 ₩**





Part1 – Determinants of having biases (reg on large bias)

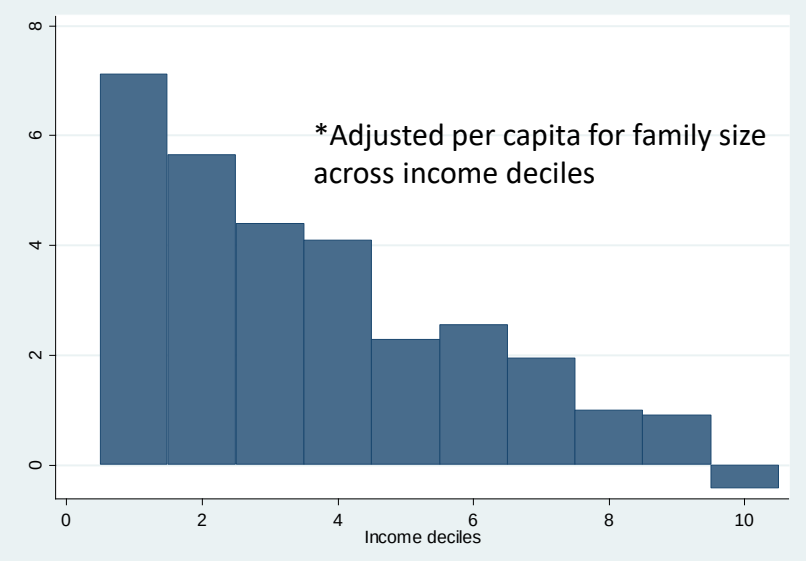
	Large bias = 1 (bias>230,000)		
VARIABLES	OLS	Logit	OLS
Political Leaning	-0.0116	-0.0127	-0.0154
(0-10, L to R)	(0.0106)	(0.0121)	(0.0106)
Response: Approve	-0.218***	-0.241***	
	(0.0323)	(0.0353)	
Responses: PNA	-0.0927**	-0.104**	
	(0.0368)	(0.0405)	
Conservative	-0.0486	-0.0527	-0.0682
	(0.0517)	(0.0585)	(0.0528)
Liberal	0.0218	0.0237	0.0185
	(0.0477)	(0.0545)	(0.0479)
Humanist	-0.0354	-0.0443	-0.0513
	(0.0622)	(0.0702)	(0.0639)
Patriot	-0.0917	-0.105	-0.111
	(0.0721)	(0.0820)	(0.0723)
Environmentalist	0.0462	0.0518	0.0242
	(0.0650)	(0.0725)	(0.0678)
Apolitical	-0.0946*	-0.105*	-0.0631
	(0.0501)	(0.0551)	(0.0498)
Professional	-0.143***	-0.153***	-0.141***
	(0.0504)	(0.0521)	(0.0508)
Self-employed	-0.0412	-0.0447	-0.0489
	(0.0488)	(0.0545)	(0.0503)
Student	-0.0271	-0.0312	0.0190
	(0.0875)	(0.0999)	(0.0868)
Home maker	-0.0670	-0.0732	-0.0724
	(0.0554)	(0.0591)	(0.0555)
Unemployed	0.0453	0.0563	0.0592
	(0.0643)	(0.0729)	(0.0664)
income	3.03e-05	4.03e-05	2.58e-05
	(8.27e-05)	(9.32e-05)	(8.45e-05)
Constant	0.455***		0.364***
	(0.0887)		(0.0872)
Socio-demographics	Included	Included	Included
Observations	1,191	1,191	1,191
R-squared	0.067		0.035
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

- Socio-demographics have **little predictive power** in identifying individuals with significant biases
  - Income, education, political leaning or being an environmentalist does not predicts having bias
  - Apolitical individuals may exhibit less resistance
  - Professionals are more likely to be well-informed
- Small R^2 suggests that independent variables only marginally explain the model
  - Biases are primarily **idiosyncratic** hard to predict
- Those who dislike the policy tend to be pessimistic
- This suggests **potential reverse causality** or **confounding factors**, such as ideology, which may significantly impact both approval and perception of policies (as in Anderson, Marinescu, and Shor, 2019)

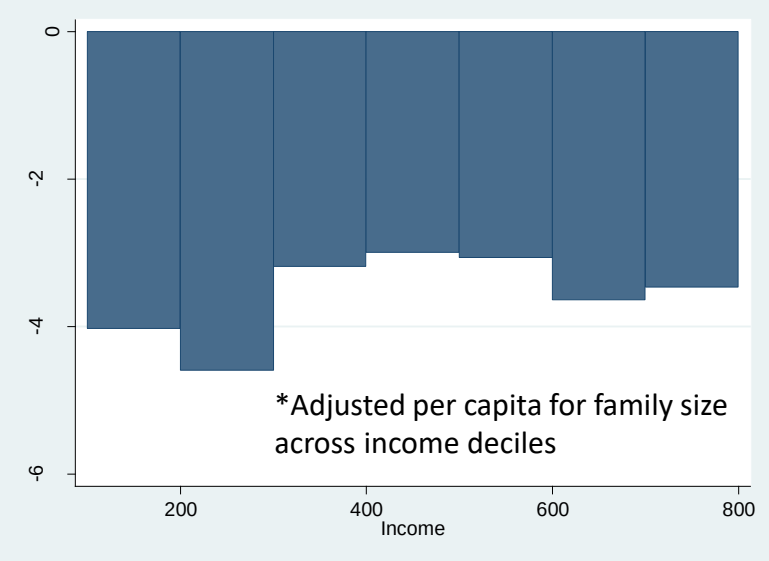
Part1 –Belief over Progressivity

- Subjects are pessimistic about the policy's progressive nature
  - All income deciles expected benefits except for the 10th
  - There is a perceived loss across all income levels, with the lowest income groups being slightly more pessimistic.

Objective net gains by income deciles(NaSTaB)



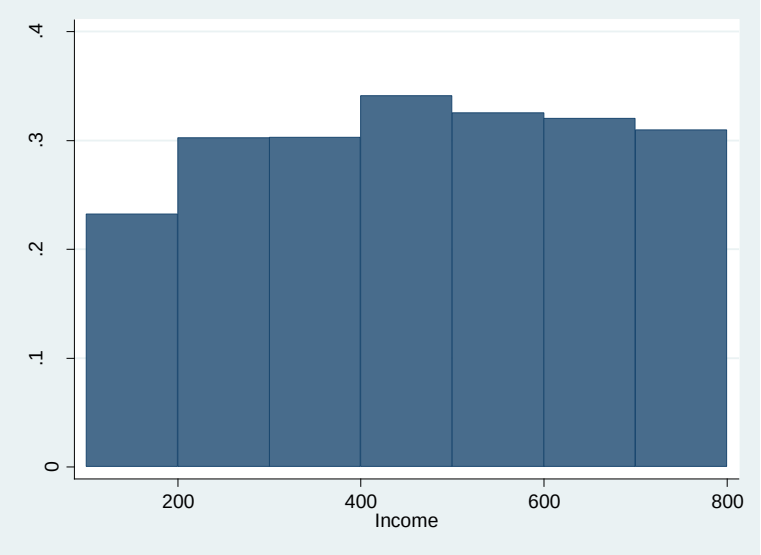
Subjective net gains by income level(perception survey)



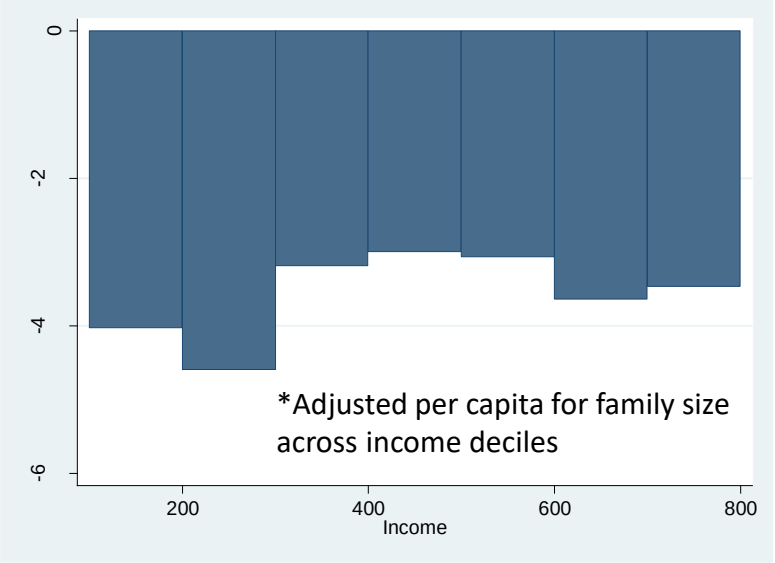
Part1 –Belief over Progressivity

- Most respondents believed the policy is regressive
  - **Only 31,7%** believed the policy is **progressive**, **50.6%** believed it **regressive** (17.6% DK/PNA)
  - **Lower income groups** are **more reluctant to believe the policy is progressive**, which aligns with their perception of subjective net gain

Proportion who believe the policy progressive



Subjective net gains by income level(perception survey)



Part1 – Belief over Progressivity

- A simple **information intervention only** had **a marginal effect** on the pessimistic belief
  - **Half of respondents** received the following information
    - "On average this policy would increase the purchasing power of the poor and decrease that of the richest who consumer more energy"
  - Marginal difference found
    - Progressive Yes: 31.0% vs 31.7%
    - Progressive No: 50.6% vs 47.1%
    - DK/PNA: 17.6% vs 21.7%

Part1 – Belief over Progressivity

- Socio-demographics have little power to predict who have a negative view on distributional effects
  - Those with large biases (on financial gain) tend to believe the policy to be regressive
    - This relationship suggests that individuals with idiosyncratic views believe the policy is unfavorable in all respects
  - Information provision marginally affects pessimistic belief
    - Does not change the views of those biased about the policy's effects (if any, boomerang effects)

	Progressive (Answered yes or DK/NO)		
	(1)	(2)	(3)
Information received	0.0419	0.0758*	0.0886**
	(0.0274)	(0.0397)	(0.0397)
Large Bias (Bias>23)		-0.106***	-0.103**
		(0.0406)	(0.0405)
Information x Large Bias		-0.0506	-0.0592
		(0.0574)	(0.0573)
Constant	0.493***	0.551***	0.532***
	(0.0195)	(0.0285)	(0.0621)
Socio-demographics			Included
Observations	1,191	1,191	1,191
R-squared	0.003	0.021	0.044
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Part1 – Belief over environmental effectiveness(EE)

- **Substantial respondents doubt** the environmental effectiveness of the policy
  - The Tax & Dividend program is predicted to **reduce HH emission by 3.6%**
  - **49.3% believed** the policy is environmental **effective**, **32.4% believed it is not**, and **18.2% answered DK/NO**

- **A tempting explanation** is that those who do not believe in the environmental effectiveness **may not adjust their consumption** of energy product (=zero elasticity)
  - However**, those who** doubt environmental effectiveness **also stated that they will reduce energy consumption**
    - Heating reduction 14.6%, transportation reduction 13.8% (among who doubt EE)
    - Heating reduction 14.0%, transportation reduction 13.2% (others)

Part1 – Belief over environmental effectiveness(EE)

- Those with **significant biases** and **men** are more likely to believe the policy is ineffective
- **Information intervention only** had a small effects on perception
  - **Half of respondents** received the following information
    - "Scientists agree that a carbon tax would effective in reducing pollution and carbon emissions"
    - Environmentally effective: 49.3% vs 53.6%, not effective: 32.4% vs 27.5%, DK/PNA: 18.2% vs 18.7%

	Environmental effectiveness : (Answered yes or DK/NO)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Elasticity (transportation)	-0.0442		-0.0380		-0.0417		-0.0596	
	(0.0453)		(0.0454)		(0.0466)		(0.0469)	
Elasticity (heating)		-0.0583		-0.0557		-0.0574		-0.0760*
		(0.0450)		(0.0450)		(0.0450)		(0.0453)
Information received			0.0505*	0.0435*	0.0573**	0.0490*	0.0544**	0.0458*
			(0.0264)	(0.0261)	(0.0263)	(0.0260)	(0.0263)	(0.0259)
Constant	0.697***	0.691***	0.674***	0.671***	0.740	0.681	0.804*	0.730
	(0.0194)	(0.0209)	(0.0229)	(0.0242)	(0.454)	(0.455)	(0.454)	(0.455)
Female					0.0886***	0.0807***	0.0882***	0.0774***
					(0.0290)	(0.0288)	(0.0289)	(0.0287)
Large Bias (Bias>23)							-0.0868***	-0.0901***
							(0.0273)	(0.0272)
Socio-demographics					Included	Included	Included	Included
Observations	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180
R-squared	0.001	0.001	0.004	0.004	0.039	0.040		
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

Part1 – Quick Summary

- **Pessimist view** on Tax and Dividend policy found
  - Respondents tend to **overestimate the negative impact** on their purchasing power
  - Most respondents **incorrectly perceive** the policy as **regressive**
  - Substantial portion **doubts** its **environmental effectiveness**

- Their misperception appears to be **largely idiosyncratic** and **not easily corrected by a simple information intervention**
  - **Observed characteristics** provide **little explanation** for the likelihood of having large biases
    - This suggest that unobserved factors(such as ideology) may simultaneously influence one's approval and perception on a carbon tax policy

Part2 – Eliciting wiliness to pay

- Practically, what is the acceptable level of carbon price and the most preferred design of carbon pricing?
  - Measuring **willingness to pay** for carbon pricing and **preference** for various policy designs
  - It is **challenging** to **find actual data** to quantitatively measure **environmental policy preferences**

- Previous studies depend on **stated preference methods** to elicit preferences over various carbon pricing policies
  - Choice experiment(CE) –Alberini et al.(2018), Beiser-McGrath and Bernauer(2019a)
  - Contingent valuation methods (CVM) – Kotchen et al.(2013), Gupta(2016), Rotaris and Danielis(2019)

- Used **both approaches** and **compared their results**

Part2 – Eliciting wiliness to pay

Choice Experiment

	Policy A	Policy B	Status Quo
1.Carbon price level	40,000₩ per ton (260,000₩/year for average HH)	60,000₩ per ton (400,000₩/year for average HH)	-
2. Exemption Clause	No exemption at all	SMEs and low income households	-
3. Implementing the policy contingent upon	No specific global political landscape	Large emitters also introducing such policy	-
4. Revenue recycling methods	Cuts to corporate tax	Investment in emission reduction technologies	-
Your choice	[ ]	[ ]	[ ]

- In a choice experiment, a **policy alternative** consists of various **combinations of attributes**
- Respondents are repeatedly asked to **select their most preferred policy** from a set of alternatives throughout the experiment
  - Their preferences are inferred through their choices

Part2 – Eliciting wiliness to pay

- **Key attributes** of carbon tax policy designs

Attributes	Levels
1.Carbon price level	{0.5만₩/ 1만₩/ 2만₩/ 4만₩/ 6만₩} per tons of CO_2eq
2. Exemption Clause	1. No exemption at all 2. Exemption for SMEs and low income households 3. Exemption for companies with many employees
3. Implementing the policy contingent upon	1. No specific global political landscape 2. Industrialized countries also introducing such policy 3. Large emitters also introducing such policy
4. Revenue recycling methods	1. No specific purpose (a transfer to public finance) 2. Carbon dividend for all 3. Investment in emission reduction technologies 4. Cuts to income or consumption tax 5. Support for socially disadvantaged groups 6. Cuts to corporate tax

- **45 sets** of alternatives were created by combining different attributes
  - The 45 questions were divided into **5 groups**, with **each group** containing **9 questions**

Part2 – Eliciting wiliness to pay

	Policy A	Policy B	Status Quo
1.Carbon price level **(T)**	40,000₩ per ton (260,000₩/year for average HH)	60,000₩ per ton (400,000₩/year for average HH)	-
2. Exemption Clause **(E)**	No exemption at all	No exemption at all	-
3. Implementing the policy contingent upon **(G)**	No specific global political landscape	Large emitters also introducing such policy	-
4. Revenue recycling methods **(R)**	Cuts to corporate tax	Investment in emission reduction technologies	-
Your choice	[ ]	[ ]	[ ]

- Estimating preference using **conditional logit** assuming **random utility model**
- *i* 's utility for policy *j* is $V_{ij} = \underbrace{\alpha T_{ij} + \sum_k \gamma_k E_{ijk} + \sum_k \beta_k G_{ijk} + \sum_k \theta_k R_{ijk}}_{\text{observed attributes } (\bar{v}_{ij})} + \underbrace{\epsilon_{ij}}_{\text{Unobserved factors}}$
- An individual i chooses policy A if $V_{iA} > V_{ij} \ \ for \ \ j \neq A$
- Assuming ϵ_{ij} follows Extreme Value type 1 distribution and normalizing $\overline{V_{iSQ}} = 0$,
  - Choice prob is $P_{ij} = \frac{\exp(\overline{v_{ij}})}{\exp(\overline{v_{i1}}) + \exp(\overline{v_{i2}}) + 1}$, and maximum likelihood estimation can be applied to estimate parameters $(\alpha, b, \gamma, \theta)$

Part2 – Eliciting wiliness to pay

- Estimation results

Attributes	Levels	Coefficients	Price conversion
1. Price	{0.5만₩/ 1만₩/ 2만₩/ 4만₩/ 6만₩} per tons of CO_2eq	-0.217***	-
2. Exemption Clause	1. No exemption at all	-	-
	2. Exemption for SMEs and low income households	-0.0143	-0.066
	3. Exemption for companies with many employees	-0.181***	-0.834
3. contingent upon	1. No specific global political landscape	-	-
	2. Industrialized countries also introducing such policy	-0.00583	-0.027
	3. Large emitters also introducing such policy	-0.0471	-0.217
4. Revenue recycling methods	1. No specific purpose (a transfer to public finance)	-	-
	2. Carbon dividend for all	0.575***	2.650
	3. Investment in emission reduction technologies	0.395***	1.820
	4. Cuts to income or consumption tax	0.528***	2.433
	5. Support for socially disadvantaged groups	0.427***	1.968
	6. Cuts to corporate tax	-0.0630	-0.290

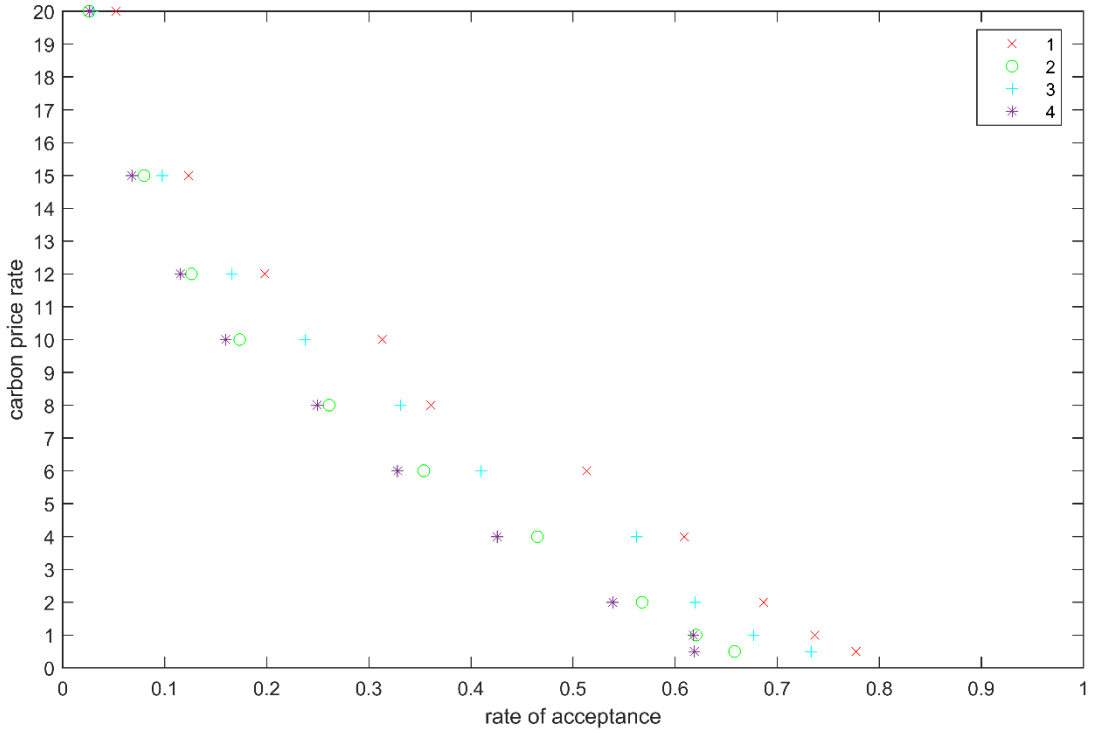
- Exemptions for companies with many employees are not preferred
- The **carbon dividend is the most preferred** revenue recycling method, **closely followed by a cut in consumption taxes**, while a **corporate tax cut is the least favored**
- To interpret the coefficients monetarily, divide them by the price coefficient of -0.217
- Using the coefficients, the acceptance rate of a policy, say A, can be measured by **Pr** $[V_{iA} > \epsilon]$

Part2 – Eliciting wiliness to pay

- **Acceptance rate simulation for selected policy scenarios**

	Exemption Clause	contingent upon	Revenue recycling
Scenario 1	SMEs' and low income	Industrialized countries	Cuts income/consumption tax
Scenario 2	SMEs' and low-income	Industrialized countries	Cuts corporate tax
Scenario 3	High-employment company	No specific global landscape	Investment in green tech
Scenario 4	High-employment company	No specific global landscape	No specific purpose

Unit: 만원



- **Policy design** significantly **affects the acceptance rate** at the same tax level
  - This shows the importance of tax design in promoting public support
- However, **the price level is a decisive factor** in accepting or rejecting policies
  - Except for mid-price range, all policies are either rejected or accepted regardless of policy scenarios

Part2 – Eliciting wiliness to pay

Contingent Valuation Methods (CVM)

- In a CVM study, respondents are **presented** descriptions of a policy

A carbon tax policy description
1. Exemption for SMEs and low income households
2. Contingent upon Industrialized countries also introducing such policy
3. Revenue recycling for Carbon dividend for all

Two variants of CVM were used

- 1. Payment card method
- **Q. The following describes characteristics of a carbon price scheme. If this carbon price scheme is planed to be introduced, how much is your annual willingness to pay?**

Price level	Check
0₩ per ton , 0₩/year for average HH	
6,000₩per ton (= gas 12.6₩/L), 25,000₩/year for average HH	
13,000₩per ton (= gas 27.3₩/L), 75,000₩/year for average HH	
20,000₩per ton (= gas 42.0₩/L), 125,000₩/year for average HH	
27,000₩per ton (= gas 56.7₩/L), 175,000₩/year for average HH	
35,000₩per ton (= gas 73.5₩/L), 225,000₩/year for average HH	
42,000₩per ton (= gas 88.2₩/L), 275,000₩/year for average HH	
50,000₩per ton (= gas 105.0₩/L), 325,000₩/year for average HH	
57,000₩per ton (= gas 119.7₩/L), 375,000₩/year for average HH	
65,000₩per ton (= gas 136.5₩/L), 425,000₩/year for average HH	
72,000₩per ton (= gas 151.2₩/L), 475,000₩/year for average HH	
80,000₩per ton (= gas 168.0₩/L), 525,000₩/year for average HH	
87,000₩per ton (= gas 182.7₩/L), 575,000₩/year for average HH	
Others	

Part2 – Eliciting wiliness to pay

Contingent Valuation Methods (CVM)

- In a CVM study, respondents are **presented** descriptions of a policy

A carbon tax policy description
1. Exemption for SMEs and low income households
2. Contingent upon Industrialized countries also introducing such policy
3. Revenue recycling for Carbon dividend for all

Two variants of CVM were used

- 2. Referendum experiment
- **Q. The following describes characteristics of a carbon price scheme. If this carbon price scheme is planed to be introduced, would you agree? Please select your approval for each price**

Price level	Affirmative	Negative	No opinion
5,000₩ per ton (gas 10.5₩/L) 30,000₩/year for average HH			
10,000₩ per ton (gas 21.5₩/L) 60,000₩/year for average HH			
20,000₩ per ton (gas 42.0₩/L) 130,000₩/year for average HH			
40,000₩ per ton (gas 84.0₩/L) 260,000₩/year for average HH			
60,000₩ per ton (gas 126.0₩/L) 400,000₩/year for average HH			
90,000₩ per ton (gas 189.0₩/L) 600,000₩/year for average HH			

Part2 – Eliciting wiliness to pay

- **Contingent Valuation Methods (CVM)**
  - **Two variants** of CVM were used

- Subjects were asked their opinions on **four policy scenarios**

	Exemption Clause	contingent upon	Revenue recycling
Scenario 1	SMEs' and low income	Industrialized countries	Cuts income/consumption tax
Scenario 2	SMEs' and low-income	Industrialized countries	Cuts corporate tax
Scenario 3	High-employment company	No specific global landscape	Investment in green tech
Scenario 4	High-employment company	No specific global landscape	No specific purpose

- Acceptance rate under **payment card** at a price level:
  - Percentage willing to **pay above** the asking price
- Acceptance rate under **referendum** at a price level:
  - Proportion of **affirmative votes**

Part2 – Eliciting wiliness to pay

- **Acceptance rate simulation** for selected policy scenarios

	Exemption Clause	contingent upon	Revenue recycling
Scenario 1	SMEs' and low income	Industrialized countries	Cuts income/consumption tax
Scenario 2	SMEs' and low-income	Industrialized countries	Cuts corporate tax
Scenario 3	High-employment company	No specific global landscape	Investment in green tech
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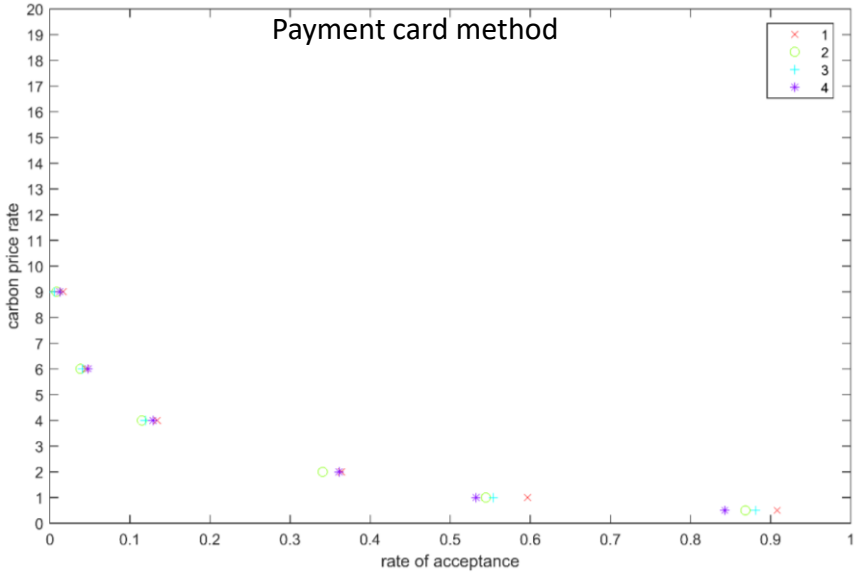

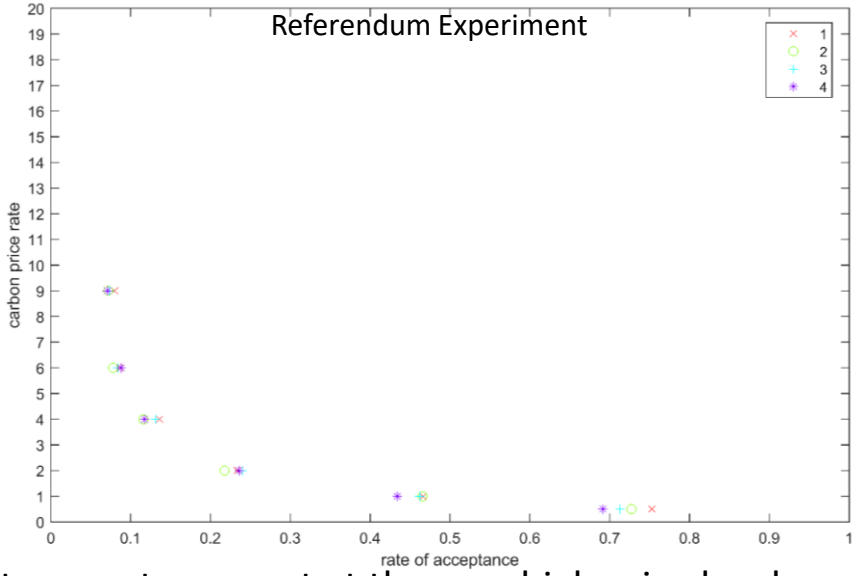

- Quantitatively, PC method shows higher acceptance rates except at the very high price level
- Qualitatively, similar outcomes are observed
  - Policy designs affect the acceptance rate only when price is low
  - The most and the least preferred policies are the same

Part2 – Eliciting wiliness to pay

- **Acceptance rate simulation** for selected policy scenarios

	Exemption Clause	contingent upon	Revenue recycling
Scenario 1	SMEs' and low income	Industrialized countries	Cuts income/consumption tax
Scenario 2	SMEs' and low-income	Industrialized countries	Cuts corporate tax
Scenario 3	High-employment company	No specific global landscape	Investment in green tech
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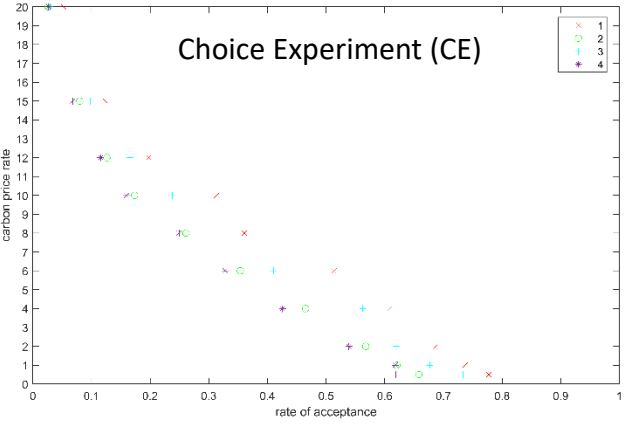
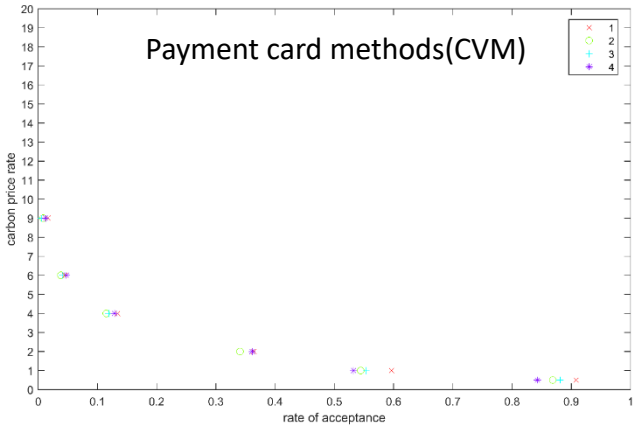
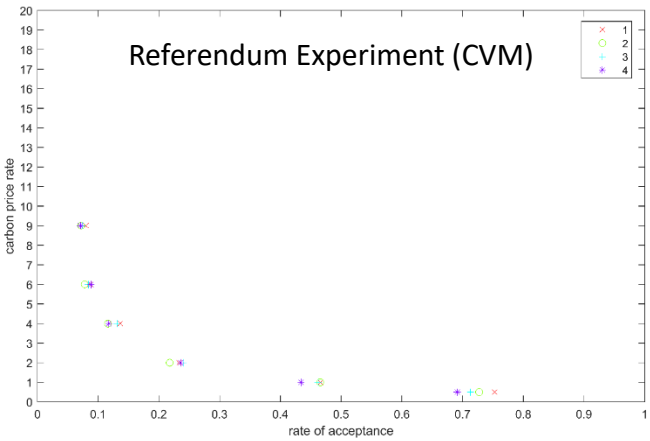






- Overall, the choice experiment shows **higher acceptance** rate
- Choice experiment shows **larger differences** in acceptance rate **across scenarios**
  - This could be attributed to the inherent differences in the decision-making process
    - In CE, subjects compare the alternatives and choose the best, while in CVM, they face a single policy
- Qualitatively, the relative preference over different policies is well maintained

Part2 – Eliciting wiliness to pay

- Calculating **average willingness to pay**

	Exemption Clause	contingent upon	Revenue recycling
Scenario 1	SMEs' and low income	Industrialized countries	Cuts income/consumption tax
Scenario 2	SMEs' and low-income	Industrialized countries	Cuts corporate tax
Scenario 3	High-employment company	No specific global landscape	Investment in green tech
Scenario 4	High-employment company	No specific global landscape	No specific purpose

- In CE, WTP is **the price** that make **the acceptance rates 50%**
- In CVM, the average over their expressed willingness to pay (payment cards)
- The average price where respondents **voted of yes** (Referendum experiment)

Unit: 만원/톤	Choice Experiment	CVM(payment card)	CVM(referendum experiment)
Scenario 1	5.92	1.74	0.54
Scenario 2	3.20	1.64	0.48
Scenario 3	4.35	1.70	0.49
Scenario 4	2.53	1.65	0.46

- Significant differences across methodologies, **failing convergence externality**
- The **rank order** among different policy scenarios is **stable**
- This implies limitations of state preference methods, which **fails to collect reliable quantitative measures of WTP**, yet **consistently elicit the relative preferences over polices**

Summary and Conclusion

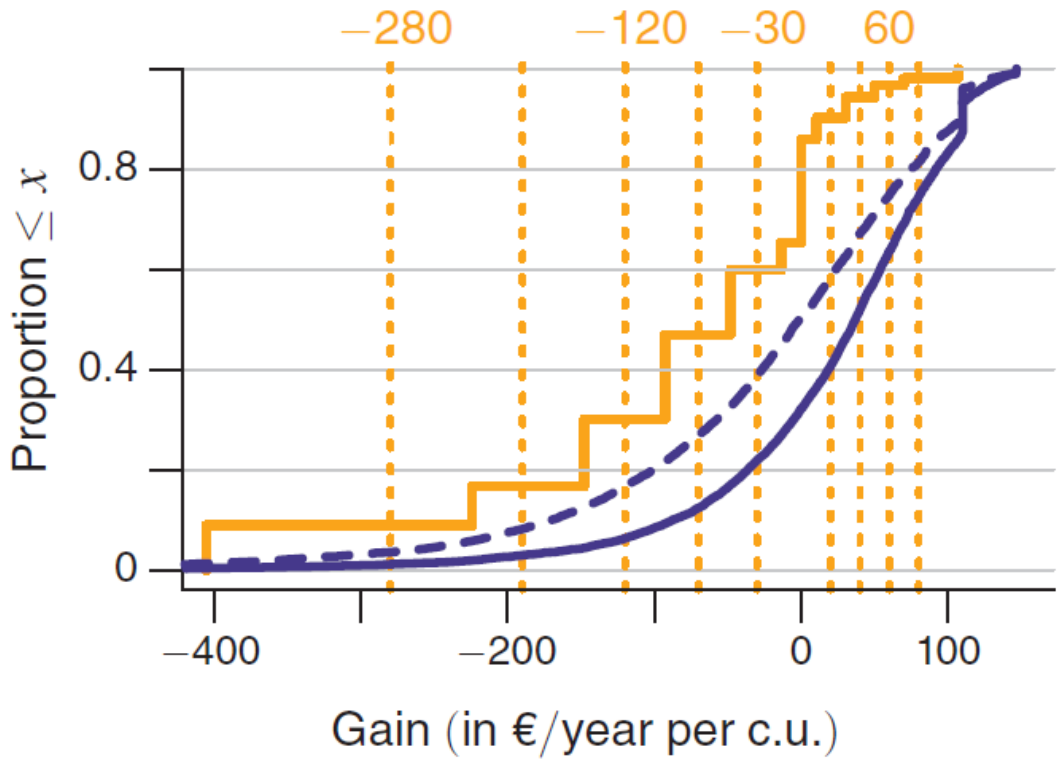
- **A pessimistic view** on the Tax and Dividend policy was found
  - Pessimistic view were found in all aspects of the policy effects: **financial, distributional, and environmental**
  - This **may lead to low approval** of a policies that are indeed progressive and environmentally beneficial
  - Their misperceptions appear to be largely **idiosyncratic** and not easily corrected by simple information interventions

- Despite taxpayers' pessimism about carbon taxes, a WTP is found to some extent
  - **Carbon dividends** and **income tax cuts** are **the most preferred** revenue recycling methods, while **corporate tax cut** and **no specific purpose** are **the least favored**
    - Taxpayers may prioritize financial gains over industry or national competence
  - Quantitatively, **stated preference methods** resulted in **different WTP** measures, **failing to achieve convergent externality**
  - All methods **consistently** identified **relative preferences** over policy scenarios

Biased belief (Douenne and Fabre, 2022)

- The subjects (in average) have a pessimistic view on the economic effects of the policy

Cumulative Density Function of Net Gains (Douenne and Fabre, 2022, p93)

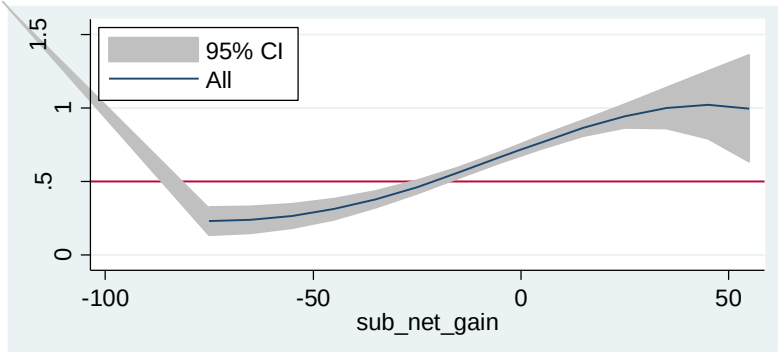


Part1- Determinants of having biases

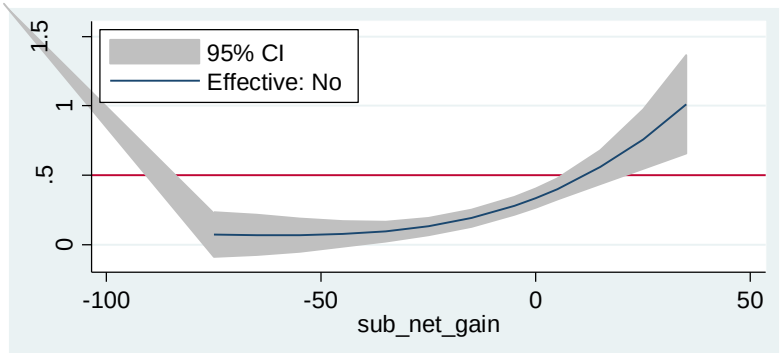
	Large bias = 1 (bias>230,000)		
VARIABLES	OLS	logit	OLS
Political Leaning	-0.0116	-0.0127	-0.0154
	(0.0106)	(0.0121)	(0.0106)
Response: Approve	-0.218***	-0.241***	
	(0.0323)	(0.0353)	
Responses: PNA	-0.0927**	-0.104**	
	(0.0368)	(0.0405)	
Conservative	-0.0486	-0.0527	-0.0682
	(0.0517)	(0.0585)	(0.0528)
Liberal	0.0218	0.0237	0.0185
	(0.0477)	(0.0545)	(0.0479)
Humanist	-0.0354	-0.0443	-0.0513
	(0.0622)	(0.0702)	(0.0639)
Patriot	-0.0917	-0.105	-0.111
	(0.0721)	(0.0820)	(0.0723)
Environmentalist	0.0462	0.0518	0.0242
	(0.0650)	(0.0725)	(0.0678)
Apolitical	-0.0946*	-0.105*	-0.0631
	(0.0501)	(0.0551)	(0.0498)
in 30s	0.0801*	0.0976*	0.0941*
	(0.0472)	(0.0547)	(0.0485)
in 40s	0.0724	0.0864	0.0843*
	(0.0486)	(0.0556)	(0.0496)
in 50s	0.0895*	0.109*	0.0684
	(0.0526)	(0.0592)	(0.0539)
in 60s	0.0711	0.0905	0.0423
	(0.0651)	(0.0740)	(0.0684)
Female	0.00862	0.0101	-0.00288
	(0.0313)	(0.0355)	(0.0317)
College graduate	-0.0587	-0.0686	-0.0468
	(0.0388)	(0.0434)	(0.0397)
Graduate school	-0.0629	-0.0804	-0.0548
	(0.0612)	(0.0694)	(0.0618)
Professional	-0.145***	-0.164***	-0.143***
	(0.0485)	(0.0528)	(0.0489)
Self-employed	-0.0412	-0.0447	-0.0489
	(0.0488)	(0.0545)	(0.0503)
Student	-0.0271	-0.0312	0.0190
	(0.0875)	(0.0999)	(0.0868)
Home maker	-0.0670	-0.0732	-0.0724
	(0.0554)	(0.0591)	(0.0555)
Unemployed	0.0453	0.0563	0.0592
	(0.0643)	(0.0729)	(0.0664)
income	3.03e-05	4.03e-05	2.58e-05
	(8.27e-05)	(9.32e-05)	(8.45e-05)
Constant	0.280***		0.193**
	(0.0856)		(0.0841)
Observations	1,191	1,191	1,191
R-squared	0.067		0.035
Robust standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

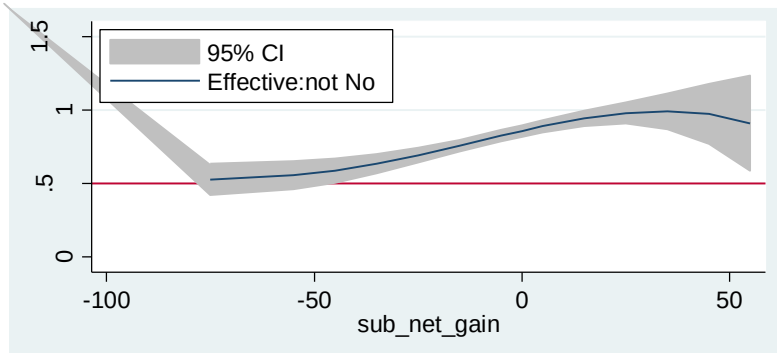
Willingness to pay

- Despite overall pessimistic belief on a carbon tax, subject are willing to pay for the policy
  - The median respondent is willing to incur a cost of 200,000₩ per year
    - This willingness to pay is higher than in a survey conducted in France (Douenne and Fabre, 2022)



- Strong heterogeneity in WTP
  - Those who doubt the environmental effectiveness of the policy are **not** willing to pay
  - Those who believe in its environmental effectiveness are much more willing to pay





Part2 – Eliciting wiliness to pay

- Calculating **average willingness to pay**

	Exemption Clause	contingent upon	Revenue recycling
Scenario 1	SMEs' and low income	Industrialized countries	Cuts income/consumption tax
Scenario 2	SMEs' and low-income	Industrialized countries	Cuts corporate tax
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Scenario 4	High-employment company	No specific global landscape	No specific purpose

- In CE, different estimation model leads to different WTP
- **Mixed logit** – the **coefficient** on price is allowed to be **random**
- **Interaction term included – sociodemographic terms** and **interactions** are included

Unit: 만원/톤	CE	CE(mixed logit)	CE(interactions)	CVM(payment card)	CVM(referendum experiment)
Scenario 1	5.92	3.63	4.00	1.74	0.54
Scenario 2	3.20	2.25	1.08	1.64	0.48
Scenario 3	4.35	2.54	2.26	1.70	0.49
Scenario 4	2.53	1.69	0.41	1.65	0.46