The Moral Cost of Carbon

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joint work with
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Carbon Pricing Implemented

In 2022, 23.17% of Global GHGs emissions were covered by a carbon pricing scheme.

KEY STATISTICS FOR 2022 ON INITIATIVE(S) IMPLEMENTED

70 Carbon pricing initiatives selected

47 National jurisdictions are covered by the initiatives selected

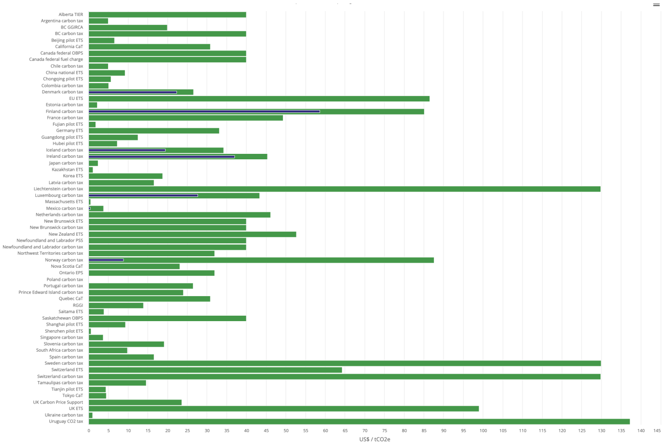
36 Subnational jurisdictions are covered by the initiatives selected

In 2022, these initiatives would cover **11.86 $GtCO_2e$**, representing **23.17%** of global GHG emissions

Source: World Bank's Carbon Pricing Dashboard

Carbon Prices

In 2022, carbon prices varied from 0.50$ (Massachusetts) to 137.30$ (Uruguay)

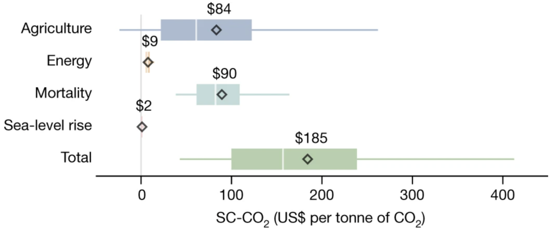


Source: World Bank's Carbon Pricing Dashboard

The Social Cost of Carbon

Fig. 3: Partial SC-CO_2 estimates and uncertainty levels strongly differ across the four climate damage sectors.

From: Comprehensive evidence implies a higher social cost of CO_2



Box and whisker plots for the climate damage sectors included in the GIVE model, based on partial SC-CO_2 estimates for each sector. The figure depicts the median (centre white line), 25%–75% quantile range (box width), and 5%–95% quantile range (coloured horizontal lines) partial SC-CO_2 values. Black diamonds highlight each sector's mean partial SC-CO_2, with the numeric value written directly above. All SC-CO_2 values are expressed in 2020 US dollars per metric tonne of CO_2.

Source: Rennert et al. 2022 (Nature)

The Carbon Pricing Gap

Carbon Prices

source: World Bank

SSC : **185**

USD/TCO2e

Switzerland **130**

USD/TCO2e

The Debate about the Future of Carbon Pricing

Le marché des crédits carbone est-il la version contemporaine du Commerce des Indulgences ?

« L'absolution pour celui qui abuse d'une jeune fille est taxée de six carlins » nous apprend Le Livre des Taxes de la Chancellerie romaine, qui fixait, avant la Contre-Réforme, si l'on en croit la tradition, le tarif des indulgences.

Foliosophy / 3 Jan

Do rich countries have a "moral responsibility" to pay for the cost of climate change?

do-rich-countries-have-a-moral-responsibility-to-pay-for-the-cost-of-climate-change

SEI /

CALL IT POLLUTION RIGHTS,' BUT IT WORKS

Washington Post / 31 Mar 1996

The Economist

Sins of emission

The idea of offsetting carbon emissions is sound in theory, if not yet in practice

The Economist / 3 Aug 2006

Two questions environmental economists are nowadays (still) being challenged on?

Can moral values close the carbon pricing gap?

Does carbon pricing erode moral values?

What we do

1. Formalize the concept of moral cost of carbon
2. Propose an experimental procedure to measure its distribution in a target population
3. Test how it interacts with extrinsic incentives
4. Investigate source of heterogeneity
5. Investigate how malleable it is with respect to the choice environment
6. Investigate its implication for policy design
7. Investigate its implication for firms' strategies

What we do: Today

1. Formalize the concept of moral cost of carbon
2. Implement an experimental procedure to measure its distribution in a target population
3. Test how it interacts with extrinsic incentives
4. ~~Investigate source of heterogeneity~~
5. ~~Investigate how malleable it is concerning the choice environment~~
6. Investigate its implication for policy design
7. ~~Investigate its implication for firms' strategies~~

Related Literature

Empirical Evidence of Moral Values

- Prosocial behavior found even in anonymous one-shot games
- Unstable altruism
  - On prosocial behaviors: *"There is thus a bewildering variety of evidence."*—Fehr and Schmidt (1999)
- Moral-motivated behavior is non-monotonic with extrinsic incentives
  - Frey (1997)'s crowding theory
  - Gneezy and Rustichini (2000)

Empirical Evidence of Moral Values

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  - Frey (1997)'s crowding theory
  - Gneezy and Rustichini (2000)

→ Moral values are heterogeneous and malleable depending on the choice environment and extrinsic incentives.

Theoretical Models Accounting for Moral Values

- Brekke, Kverndokk, and Nyborg (2003): Model of self-identify based on a moral ideal (the ideal effort level each of us should provide). People choose their actions to meet this moral ideal.

- Bénabou and Tirole (2011): Model of endogenous self-identify where actions and beliefs determine the "stock" of moral values.
  - *"The central ingredient in the model is indeed that people are, at times, unsure of their own deep preferences: moral standards, concern for others, strength of faith, etc."*
  - *"...the (moral) stock from which an individual will eventually derive benefits may prove to be very important to his long-run welfare, or not that meaningful."*

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  - *"...the (moral) stock from which an individual will eventually derive benefits may prove to be very important to his long-run welfare, or not that meaningful."*

→ Moral values are intertwined with beliefs about an individual's actions. They may influence decision utility but not experienced utility.

Formalizing the moral cost of carbon

Defining the Moral Cost of Carbon

The moral cost has two components :

- μ: marginal moral tax a consumer is willing to apply to the externality
  - A behavioral parameter that impacts decision utility only.
  - Malleable w.r.t. choice environment and extrinsic incentives.

- $\mathcal{B}(\cdot)$: Beliefs about consumer's own action on the externality

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Example:

- E is energy
- $U(E)$ is consumption utility over E

$$U(E) - \mu \cdot \mathcal{B}(E)$$

$\rightarrow$ This will be our workhorse (poney) model.

Reminder: SCC and Optimal Climate Policy

- The GVT sets a tax τ.
- Energy, E, produces an externality.
- The carbon externality (measured by the SCC) is δ.
- Government revenues are redistributed lump-sum.
- Price of energy, p is fixed (in fact 0 w.l.o.g.)

Consumer's problem

$$\max_{E} U(E^*) - \tau \cdot E$$

F.O.C.

$$U'(E) = \tau$$

GVT's problem

$$\max_{\tau} U(E^*) - \tau \cdot E^* - \delta \cdot E^* + \tau \cdot E^*$$

Taking the total derivative (assuming $\frac{dE^*}{d\tau} \neq 0$)

$$U'(E^*) = \delta$$

$$\tau = \delta$$

Optimal Tax with Moral Cost

- μ : marginal moral cost
- $\mathcal{B}(E) = E$

Consumer's problem (Decision utility)

$$\max_{E} U(E) - (\tau + \mu) \cdot E$$

F.O.C.

$$U'(E^*) = \tau + \mu$$

GVT's problem (Experienced utility)

$$\max_{\tau} U(E^*) - \delta \cdot E^*$$

Total Derivative

$$U'(E^*) = \delta$$

$$\tau = \delta - \mu$$

Consumer has biased beliefs

- Suppose that the *true* level of the externality is $\alpha \cdot E$ ($\alpha = 1$ w.l.o.g.), but the consumer's beliefs are $\mathcal{B}(E)$.
- $\mathcal{B}'(E) < 1$: undervaluation of the externality
- $\mathcal{B}'(E) > 1$: overvaluation of the externality

Consumer's problem (Decision utility)

$$\max_E U(E) - (\tau + \mu) \cdot \mathcal{B}(E)$$

F.O.C.

$$U'(E^*) = (\tau + \mu) \cdot \mathcal{B}'(E^*)$$

GVT's problem (Experienced utility)

$$\max_\tau U(E^*) - \delta \cdot E^*$$

Total Derivative

$$U'(E^*) = \delta$$

$$\tau = \frac{\delta}{\mathcal{B}'(E)} - \mu$$

Heterogeneity

- Preferences, moral cost, and beliefs are heterogeneous.
- Let's define $E_i^*(\tau)$, the optimal quantity solving the problem of consumer i.
- σ_i: share of consumer of type i.

Consumer i's problem

$$\max_E U_i(E) - (\tau + \mu_i) \cdot \mathcal{B}_i(E)$$

F.O.C.

$$U_i'(E^*) = (\tau + \mu_i) \cdot \mathcal{B}_i'(E^*)$$

GVT's problem

$$\max_\tau \sum_i^N \sigma_i \cdot (U_i(E_i^*(\tau)) - \delta \cdot E_i^*(\tau))$$

F.O.C.

$$\sum_i^N \sigma_i \cdot \frac{dE_i^*(\tau)}{d\tau} \cdot (U_i'(E^*) - \delta) = 0$$

$$\tau = \delta \cdot \frac{\sum_i^N \sigma_i \cdot \frac{dE_i^*}{d\tau}}{\sum_i^N \sigma_i \cdot \frac{dE_i^*}{d\tau} \cdot \mathcal{B}_i'(E^*)} - \frac{\sum_i^N \sigma_i \cdot \frac{dE_i^*}{d\tau} \cdot \mu_i \cdot \mathcal{B}_i'(E^*)}{\sum_i^N \sigma_i \cdot \frac{dE_i^*}{d\tau} \cdot \mathcal{B}_i'(E^*)}$$

What we need to know

The optimal second-best price instrument:

$$\tau = \delta \cdot \frac{\sum_i^N \sigma_i \cdot \frac{dE_i^*}{d\tau}}{\sum_i^N \sigma_i \cdot \frac{dE_i^*}{d\tau} \cdot \mathcal{B}_i'(E^*)} - \frac{\sum_i^N \sigma_i \cdot \frac{dE_i^*}{d\tau} \cdot \mu_i \cdot \mathcal{B}_i'(E^*)}{\sum_i^N \sigma_i \cdot \frac{dE_i^*}{d\tau} \cdot \mathcal{B}_i'(E^*)}$$

- To determine if moral values close the carbon pricing gap, we need to know the joint distribution of:

$$\left\{ \frac{dE_i^*}{d\tau}, \mu_i, \mathcal{B}_i'(E) \right\}$$

- In this paper, we will focus on estimating the discrete distribution σ_i, where $\sum_i^N \sigma_i = 1$, for

$$\left\{ \mu_i, \mathcal{B}_i'(E) \right\}$$

Experimental Design:
Measuring the Moral Cost of Carbon

Outline: Our Approach

- Artefactual field experiment
  - "Normal" people making "normal" consumption choices in a controlled online environment
- Realistic binary choice task: holiday packages that differ w.r.t. their carbon footprint
  - Within and across subject manipulation of information and incentives
  - For each subject: several incentive compatible elicitations of WTP
- Belief elicitation
- Multiple choice tasks

Framework for Experimental Design

Consumer i makes a binary choice between two options: a L (low-carbon) good and a H (high-carbon) good.

- $U_i^L = v_i^L - p^L - \mu_i \cdot \mathcal{B}_i(e^L)$
- $U_i^H = v_i^H - p^H - \mu_i \cdot \mathcal{B}_i(e^H)$
- $\Delta U_i = U_i^L - U_i^H = \Delta v_i - \Delta p - \mu_i \cdot \mathcal{B}_i(\Delta e)$

Recovering μ_i

- **Step 1.** Baseline WTP elicitation, we are looking for the amount a_i such that:

$$\Delta U_i = \Delta v_i - \mu_i \cdot \mathcal{B}_i(\Delta e) - \Delta p + a_i = 0 \quad (1)$$

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- **Step 2.** Information treatment ("perfect debiasing") pins down the beliefs of all treated subjects, i.e.,:
  - $\mathcal{B}_i(\Delta e) = \Delta e \;\; \forall \text{ treated } i$

Recovering μ_i

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- **Step 3.** Follow-up WTP elicitation, we are looking for the amount a_i' such that:

$$\Delta U_i = \Delta v_i - \mu_i \cdot \Delta e - \Delta p + a_i' = 0 \qquad (2)$$

Recovering μ_i

Using Equations (2) and (1), we have

$$a_i' - a_i = \mu_i \cdot \Delta e - \mu_i \cdot \mathcal{B}_i(\Delta e), \tag{3}$$

$$\mu_i = \frac{a_i' - a_i}{\Delta e - \mathcal{B}_i(\Delta e)} \tag{4}$$

where

- a_i: baseline WTP elicitation
- a_i': follow-up WTP elicitation after information treatment
- Δe: information treatment
- $\mathcal{B}_i(\Delta e)$: belief elicitation

Experimental Design

Household Panel

Baseline WTP Elicitation

Belief Elicitation

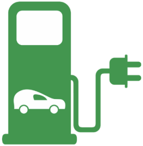
No information | **Carbon footprint disclosure**

WTP Elicitation
no information

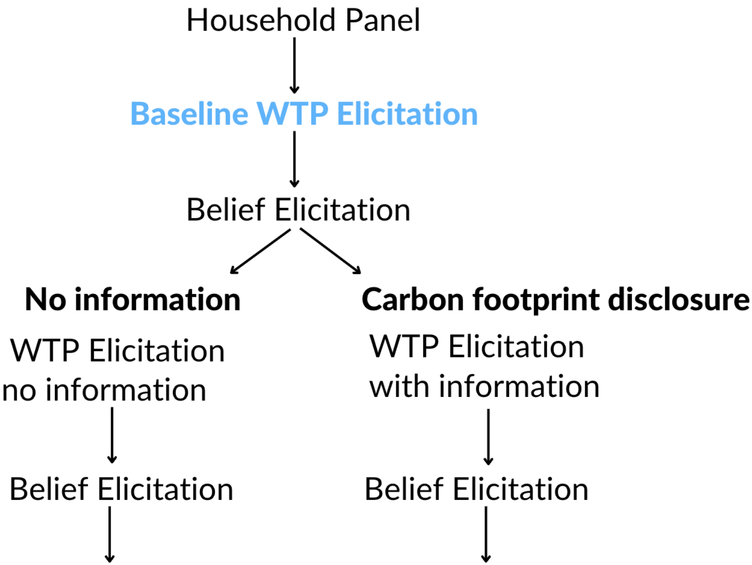
WTP Elicitation
with information

Choice Environment

As a token of appreciation to the members of our Grenoble Citizen Panel (more on this later), we offered a week-end for two persons in Chamonix.

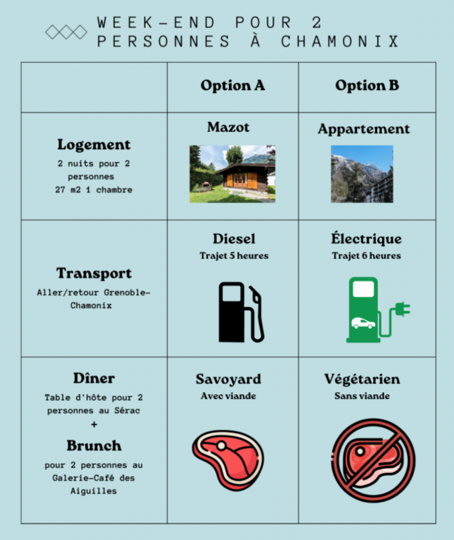


Experimental Design



Baseline WTP (a_i)

Each participant first makes a binary choice between two holiday packages:

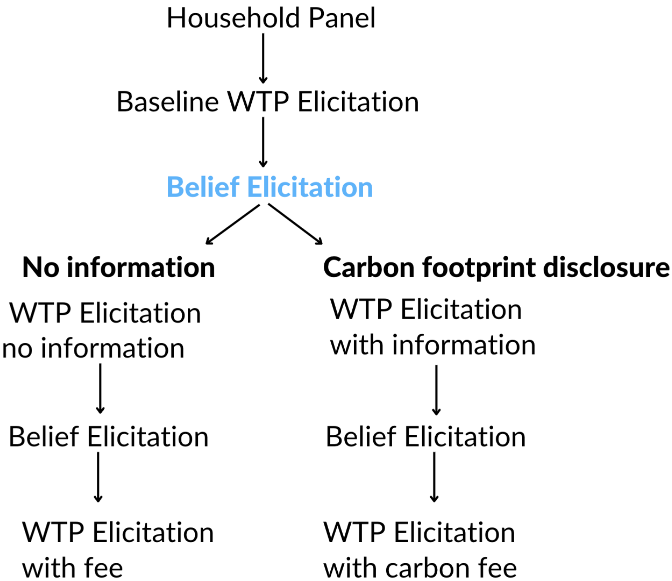


Baseline WTP (a_i)

A follow-up question offers a compensation (pocket money) for the least preferred option (say B here). The switching point consists of the amount a_i s.t. $\Delta U_i(a_i) = 0$

Ligne n°:	**Option A** **Mazot + Voiture diesel** **+ Repas traditionnels** **+ Argent de poche reçu**	**Option B** **Appartement + Voiture** **électrique + Repas végétariens** **+ Argent de poche reçu**	**OPTION A**	**OPTION B**
1	+0€	+0€	○	○
2	+0€	+5€	○	○
3	+0€	+10€	○	○
4	+0€	+15€	○	○
5	+0€	+20€	○	○
6	+0€	+25€	○	○

Experimental Design



Beliefs Elicitation (Step 1)

- We used a multiple-choice question to identify participants that did not think about the carbon footprint in the baseline WTP elicitation.
- For those, we will assume: $B_i(\Delta e) = 0$.

Parmi les facteurs suivants, lesquels avez-vous pris en compte lorsque vous avez effectué vos choix dans les questions précédentes ? (plusieurs réponses possibles)

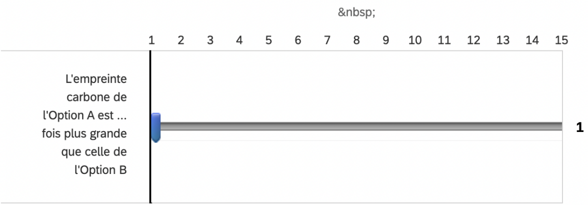
- ☐ Les goûts de la personne qui m'accompagnerait si je gagnais le séjour
- ☐ L'empreinte carbone des deux options
- ☐ La valeur monétaire des deux options
- ☐ Le confort des deux options
- ☐ Aucun de ces facteurs

Example: Beliefs Elicitation (Step 2)

- We used a scale to pin down: $B_i(e^H/e^L)$.
- We will assume that: $B_i(\Delta e) = B_i(e^H/e^L) \cdot e^L - e^L$.

A votre avis, l'empreinte carbone de l'**Option A** (mazot / voiture diesel / repas traditionnels) est **combien de fois plus grande** que celle de l'**Option B** (appartement / voiture électrique / repas végétariens) ?

Par exemple, si vous placez le curseur sur le **1**, vous pensez que l'empreinte carbone de l'**Option A** est **identique à celle de l'Option B;** si vous placez le curseur sur le **2**, vous pensez que l'empreinte carbone de l'**Option A** est **deux fois plus grande** que celle de l'**Option B**, et ainsi de suite. Vous pouvez placer le curseur entre deux chiffres.



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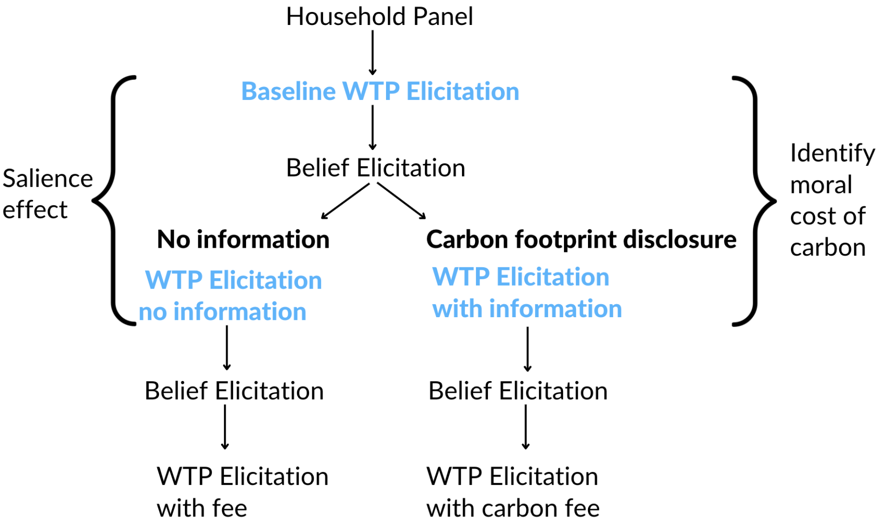
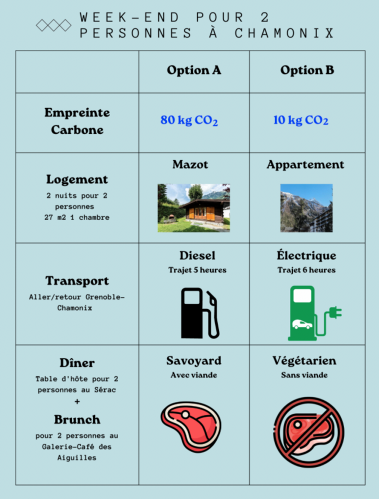


WTP with information (a'_i)

- 50% of participants: binary choice with carbon footprint information.
- 50% of participants: baseline binary choice.



WEEK-END POUR 2 PERSONNES À CHAMONIX

	Option A	Option B
Empreinte Carbone	80 kg CO_2	10 kg CO_2
Logement 2 nuits pour 2 personnes 27 m2 1 chambre	**Mazot**	**Appartement**
Transport Aller/retour Grenoble-Chamonix	**Diesel** Trajet 5 heures	**Électrique** Trajet 6 heures
Dîner Table d'hôte pour 2 personnes au Sérac + **Brunch** pour 2 personnes au Galerie-Café des Aiguilles	**Savoyard** Avec viande	**Végétarien** Sans viande

Recovering the distribution of μ_i

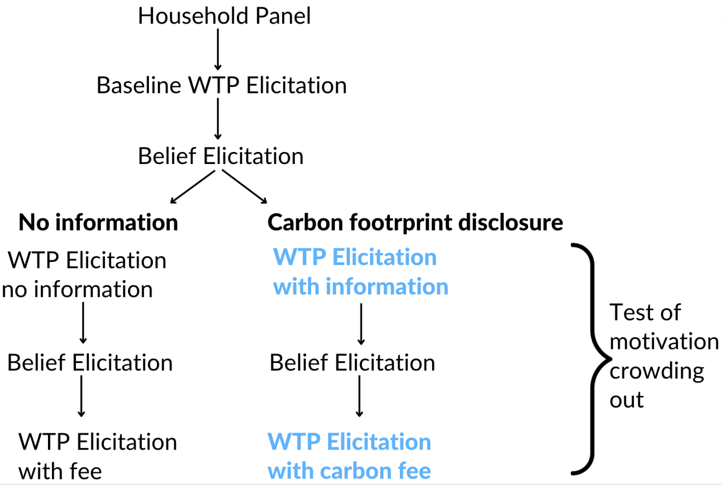
If Step 1 of belief elicitation suggests $\mathcal{B}_i(\Delta e) = 0$, then:

$$\mu_i = \frac{a_i' - a_i}{\Delta e}$$

Otherwise:

$$\mu_i = \frac{a_i' - a_i}{\Delta e - \mathcal{B}_i(\Delta e)}$$

Experimental Design



Testing for Motivation Crowding-Out

Under full disclosure, suppose we add a carbon tax τ and elicitate the amount a_i'' such that:

$$\Delta U_i = \Delta v_i - (\mu_i(\tau) + \tau) \cdot \Delta e - \Delta p + a_i'' = 0 \tag{5}$$

Remember, the WTP elicitation with full disclosure determines the amount a_i' such that:

$$\Delta U_i = \Delta v_i - \mu_i \cdot \Delta e - \Delta p + a_i' = 0 \tag{6}$$

Therefore, Equation $5 - 6$ gives:

$$\mu_i(\tau) - \mu_i = \frac{a_i'' - a_i'}{\Delta e} - t, \tag{7}$$

which can be used to test if $\mu_i(\tau) - \mu_i \neq 0$, i.e., extrinsic incentive impacts intrinsic motivation.

Testing for Motivation Crowding-Out

Extrinsic incentive implies

- No crowding-out: $\frac{\partial \mu(\tau)}{\partial \tau} = 0$
- Partial crowding-out: $-1 < \frac{\partial \mu(\tau)}{\partial \tau} < 0$
- Complete crowding-out: $\frac{\partial \mu(\tau)}{\partial \tau} = -1$
- Backfire crowding-out: $\frac{\partial \mu(\tau)}{\partial \tau} < -1$

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Empirically, we will test:

$$\mu_i(\tau) - \mu_i \neq 0$$

and

$$\mu_i(\tau) - \mu_i \neq -\Delta\tau$$

Implementation Details

- Sample: Grenoble Citizen Panel
  - Collaboration between the City of Grenoble and GEM
  - 1500+ citizens representative of Grenoble metro area
  - Solicited 3-5/year to complete online survey of various topics
- This study: lottery as a token of appreciation
  - Lottery used a MPL procedure (incentive compatible)
  - Value of 1500 Euros
  - Study conducted in May 2022
  - Package offered in October 2022
- Recruitment via Panel's usual procedure
  - 724 participants started the study
  - 580 final sample
- Well-balanced control and treatment groups

Results

Reduced-Form Analysis

We elicited 5 different WTPs, where each WTP corresponds to:

$$WTP_i = U_i^L - U_i^H = \Delta U_i(\text{carbon}, \text{fee})$$

- carbon is the signal about carbon footprint.
  - No: no information revealed (baseline elicitation)
  - Salient: belief elicitation increases salience in the control group
  - Perfect: treatment information provides perfect information to the treatment group
- fee: fee amount

		Control	**Treatment**
t=0	Baseline WTP	$\Delta U_i(\text{No}, 0)$	$\Delta U_i(\text{No}, 0)$
t=1	Follow-up WTP	$\Delta U_i(\text{Salient}, 0)$	$\Delta U_i(\text{Perfect}, 0)$
t=2	Fee WTP	$\Delta U_i(\text{Salient}, 10)$	$\Delta U_i(\text{Perfect}, 10)$

Reduced-Form Analysis

Estimating each of the effects at once:

$$WTP_{it} = \alpha + \beta \, Treated_i + \sum_{t=1}^{2} \gamma_t D_t + \sum_{t=1}^{2} \phi_t \, Treated_i \times D_t + \epsilon_{it}$$

Reduced-Form Analysis

Estimating each of the effects at once:

$$WTP_{it} = \alpha + \beta\, Treated_i + \sum_{t=1}^{2} \gamma_t D_t + \sum_{t=1}^{2} \phi_t\, Treated_i \times D_t + \epsilon_{it}$$

		Control	Treatment
t=0	Baseline WTP	$\alpha = -12.8_{(-3.45)}$	$\beta = -5.2_{(-1.01)}$
t=1	Follow-up WTP		
t=2	Fee WTP		

t-stats in parentheses

→ People preferred the high-carbon package on average.
→ Small but not statistically significant difference for the treatment group.

Reduced-Form Analysis

Estimating each of the effects at once:

$$WTP_{it} = \alpha + \beta \, Treated_i + \sum_{t=1}^{2} \gamma_t D_t + \sum_{t=1}^{2} \phi_t \, Treated_i \times D_t + \epsilon_{it}$$

		Control	Treatment
t=0	Baseline WTP	$\alpha = -12.8_{(-3.45)}$	$\beta = -5.2_{(-1.01)}$
t=1	Follow-up WTP	$\gamma_1 = +8.9_{(2.09)}$	$\phi_1 = +22.2_{(6.14)}$
t=2	Fee WTP		

$\rightarrow$ Small salience effect of belief elicitation. (No preference reversal on average: $-12.8 + 8.9 < 0$)

$\rightarrow$ Large effect of carbon footprint disclosure. (Preference reversal on average: $-12.8 - 5.2 + 22.2 > 0$)

Reduced-Form Analysis

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		Control	**Treatment**
t=0	Baseline WTP	$\alpha = -12.8_{(-3.45)}$	$\beta = -5.2_{(-1.01)}$
t=1	Follow-up WTP	$\gamma_1 = +8.9_{(2.09)}$	$\phi_1 = +22.2_{(6.14)}$
t=2	Fee WTP	$\gamma_2 = +16.5_{(2.46)}$	$\phi_2 = +19.1_{(3.97)}$

→ A 10€ fee on the high-carbon package increases the WTP for the low-package by $16.9 - 8.9 = 7.57$€. (Cannot reject the null that the difference is 10€.)

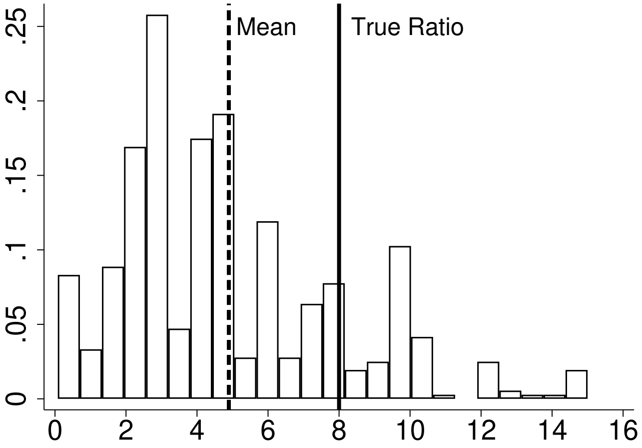
→ The marginal impact of carbon disclosure is reduced when there is a fee: $19.1 - 22.2 = -3.1$€. (Cannot reject the null that the difference is 0.)

Recovering the Distribution: $\{\mathcal{B}_i(\cdot), \mu_i\}$

Part 1: Recovering Beliefs

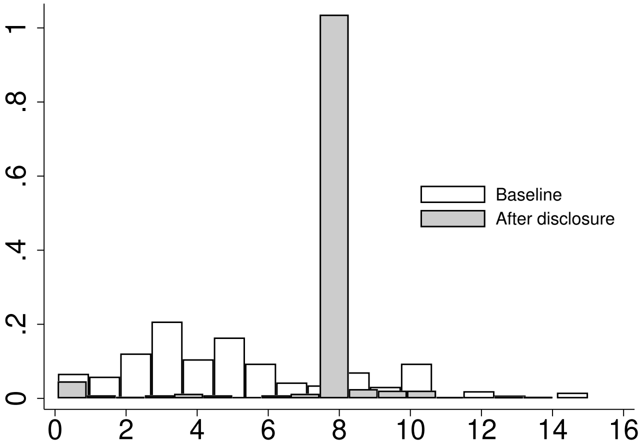
- 66.8% did not consider the carbon footprint in the baseline choice.
- Underestimation of the difference in carbon footprint.
- Information disclosure corrected beliefs.

Results: Baseline Beliefs



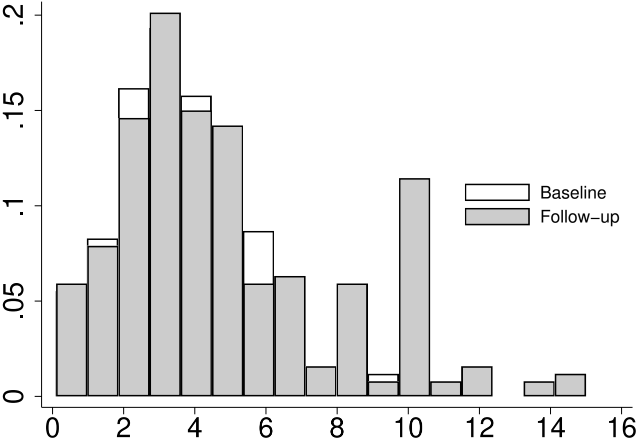
The x-axis is the ratio of the high-carbon footprint (80 kg CO_2eq) on the low-carbon footprint (10 kg of CO_2eq).

Effectiveness of the Treatment on Beliefs



The x-axis is the ratio of the high-carbon footprint (80 kg CO_2eq) on the low-carbon footprint (10 kg of CO_2eq).

Stable Beliefs for Control Group



The x-axis is the ratio of the high-carbon footprint (80 kg CO_2eq) on the low-carbon footprint (10 kg of CO_2eq).

Reminder: Recovering μ_i

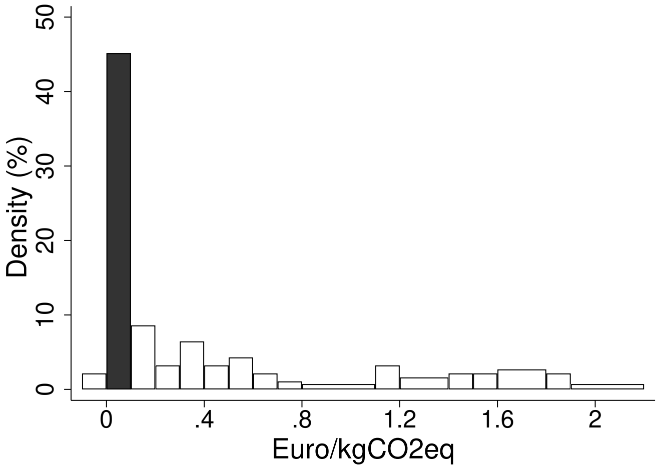
The moral cost is identified as follows:

$$\mu_i = \frac{a_i' - a_i}{\Delta e - \mathcal{B}_i(\Delta e)}$$

We have, however, two types:

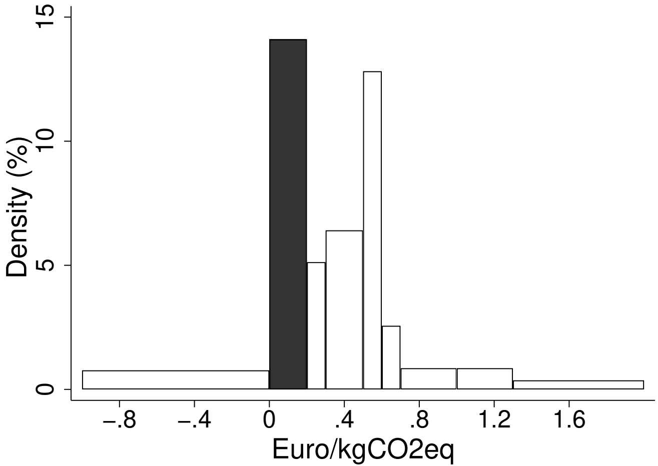
- Carbon-inattentive type (66.8%): Belief elicitation suggests $\mathcal{B}_i(\Delta e) = 0$:
$$\mu_i = \frac{a_i' - a_i}{\Delta e}$$
- Carbon-attentive type (33.2%): Belief elicitation suggests $\mathcal{B}_i(\Delta e) \neq 0$:
$$\mu_i = \frac{a_i' - a_i}{\Delta e - \mathcal{B}_i(\Delta e)}$$

Distribution of μ_i for Carbon-Inattentives



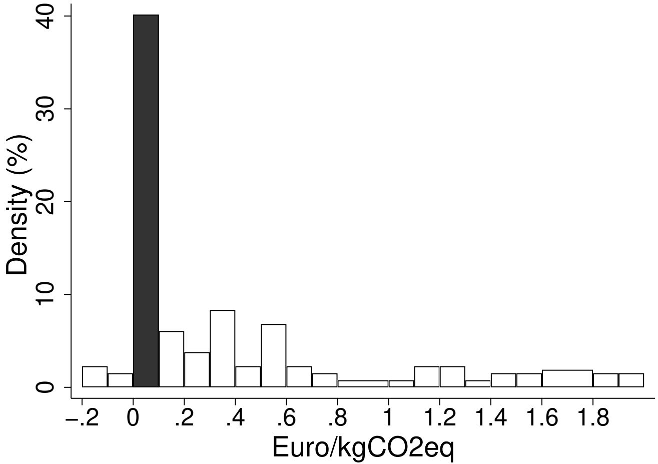
Distribution of $\mu_i(\tau)$ for people who did not consider the carbon footprint in the baseline choice and for which the treatment led to correct beliefs ($\mathcal{B}_i(\Delta e) = \Delta e = +/- 10\mathrm{kgCO2eq}$).

Distribution of μ_i for Carbon-Attentives



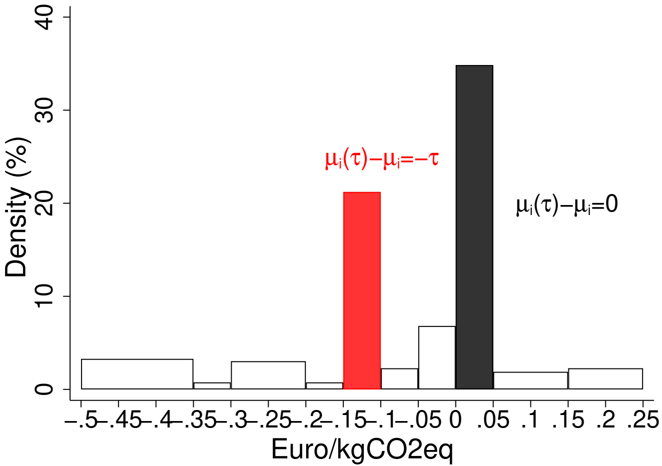
Distribution of $\mu_i(\tau)$ for people who considered the carbon footprint in the baseline choice and for which the treatment led to correct beliefs.

Distribution of μ_i: All Treated



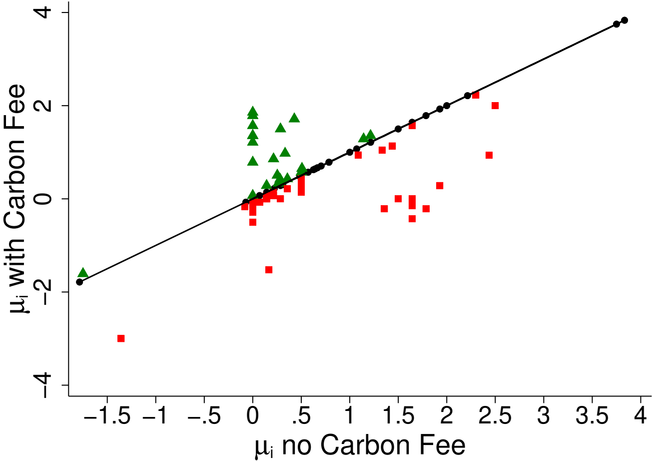
Distribution of $\mu_i(\tau)$ for all treated participants. Sample is restricted to participants for which the treatment led to correct beliefs.

Crowding-out? Distribution of $\mu_i(\tau) - \mu_i$



Distribution of $\mu_i(\tau) - \mu_i$. At zero (in black), we have $\mu_i(\tau) = \mu_i$. The red bar denotes the distribution where the carbon fee induces a complete crowding out of the moral cost, i.e., $\mu_i(\tau) - \mu_i = -\tau$.

Crowding-out? Distribution of $\mu_i(\tau)$ vs μ_i



Summary Results

- Without disclosure:
  - Large share of carbon-inattentives: 67%
  - Among carbon-attentives, 13% have a moral cost of zero.
  - → For 80% of the population, carbon footprint does not impact decisions.
- With disclosure:
  - Pure information impacts beliefs: >90% are debiased.
  - 45% of the population have a moral cost of zero.
  - For the others, mean moral cost: 1.0 Euro/kgCO_2eq.
- With carbon fee:
  - No crowding-out: $\frac{\partial \mu(\tau)}{\partial \tau} = 0$: 35%
  - Partial crowding-out: $-1 < \frac{\partial \mu(\tau)}{\partial \tau} < 0$: 10%
  - Complete crowding-out: $\frac{\partial \mu(\tau)}{\partial \tau} = -1$: 19%
  - Backfire crowding-out: $\frac{\partial \mu(\tau)}{\partial \tau} < -1$: 18%
  - Moral activation: $-\frac{\partial \mu(\tau)}{\partial \tau} > 0$: 18%

Policy Implications

Policy Implications

Though experiment:

- For a given SCC, what is the optimal Pigouvian tax adjusted for the distribution of $\{\mathcal{B}_i(E), \mu_i\}$?

Set-up:

- H1: Constant marginal bias: $\mathcal{B}_i(E^*) = \theta_i \cdot E \rightarrow \mathcal{B}_i'(E^*) = \theta_i$
- H2: Constant marginal externality: $\frac{\partial E_i^*}{\partial \tau} = k$
- Our optimal tax formula becomes:

$$\tau = \frac{\delta}{\sum_i^N \sigma_i \cdot \theta_i} - \frac{\sum_i^N \sigma_i \cdot \mu_i \cdot \theta_i}{\sum_i^N \sigma_i \cdot \theta_i}$$

Results: Policy Analysis

Under no carbon disclosure (baseline choice):

- $SCC = 50 \rightarrow \tau = -383$
- $SCC = 150 \rightarrow \tau \approx 0$
- $SCC = 210 \rightarrow \tau \approx 220$

With carbon disclosure:

- $SCC = 50 \rightarrow \tau = -483$
- $SCC = 150 \rightarrow \tau \approx -383$
- $SCC = 533 \rightarrow \tau \approx 0$

With crowding-out: work-in-progress!

Discussions

Some Introspection

- Is the Moral Cost of Carbon useful for policy design?
  - To this day, hard for people (my students) to comprehend the most celebrated result of environmental economics does not require **any information about preferences and consumer behaviors**.
- Should we measure the Moral Cost of Carbon at scale?
  - We spent 7k Euros to run this study. Shall we spend 100k or 1M?
  - IAMs used to computed the SCC cost millions to develop and run.
  - Greenstone et al. ran a RCT to test cap-and-trade in India and spent up to 10M.
- Is the Moral Cost of Carbon useful for firm's strategies?
  - Easier for firms to design experiments to elicit the moral cost of carbon in their particular market.
  - Clear implications for firms' product and information disclosure strategies.

Our Next Steps

- Stability of μ_i across domains.
- Stability of μ_i across time.
- How does μ_i correlate with demographics?
- Identifying μ_i with natural field experiments.


...and collect more field data!