

To Mitigate or Not to Mitigate: The Price Elasticity of Pro-Environmental Behavior

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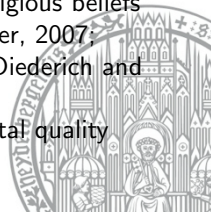
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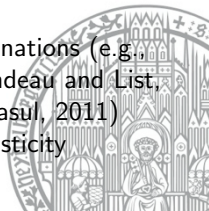
Introduction

- Voluntary demand for environmental quality as an important complement (substitute?) for other types of regulation
 - ▶ Pro-environmental behavior (PEB)
- Factors influencing PEB
 - ▶ Income (e.g. Clark, Kotchen, and Moore, 2003; Kotchen and Moore, 2007)
 - ▶ Education, knowledge, information (Bamberg and Möser, 2007; Diederich and Goeschl, 2014)
 - ▶ Presence of offsetting behavior (Kotchen, 2006; Kotchen and Moore, 2007; Jacobsen, Kotchen, and Vandenberg, 2012)
 - ▶ Attitudes, moral and social norms, feelings of guilt, religious beliefs (Clark, Kotchen, and Moore, 2003; Bamberg and Möser, 2007; Kotchen and Moore, 2007; Owen and Videras, 2007; Diederich and Goeschl, 2014)
 - ▶ Expected personal benefits from improved environmental quality (Diederich and Goeschl, 2014)



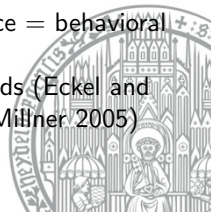
Introduction

- How about the *price* of PEB?
 - ▶ Has received less explicit attention
 - ▶ Hard to observe: Often implicit (opportunity cost of time or effort spent, donations)
- Various approaches:
 - ▶ Empirically observed variations in marginal income tax rate for tax-deductible donations (Feldstein and Taylor, 1976; Feldstein and Clotfelter, 1976; Eubanks and Wyckoff, 1989; Yen, Boxall, and Adamowicz, 1997)
 - ▶ Empirically observed price premiums for “green goods” (Kotchen and Moore, 2007; Mewton and Cacho, 2011)
 - ▶ Experimentally induced variation of *match rates* for donations (e.g., Karlan and List, 2007; Eckel and Grossman, 2008; Rondeau and List, 2008; Kotani, Messer, and Schulze, 2010; Huck and Rasul, 2011)
 - ▶ Stated preferences data can be used to derive price elasticity



Indirect price variation in experiments (matches and rebates)

- Has numerous advantages:
 - ▶ Randomized assignment
 - ▶ Realism
 - ▶ Ease of implementation
 - ▶ Theoretically straightforward to convert (e.g., going from a 1:0 match ratio to 1:1 is equivalent to a 50% rebate or a 50% price decrease)
- But subjects do not see different prices. They see different match ratios or rebates. A problem?
- Drawbacks of the indirect approach
 - ▶ Reliance on implicit assumption: theoretical equivalence = behavioral equivalence
 - ▶ Refuted in the lab and field for public (charitable) goods (Eckel and Grossman 2003, 2008) and private goods (Davis and Millner 2005)
 - ▶ Indirect price variation \neq direct price variation
 - ▶ Match rate elasticity \neq price elasticity



This paper

- *Direct variation in the price of PEB*
 - ▶ Subjects randomly assigned to an amount of money to give up to supply a unit of PEB
 - ▶ PEB: climate change mitigation
 - ▶ Unit: abatement of 1t CO₂
 - ▶ Vehicle: Withdraw Phase II EU emissions allowances (EUA) from EU-ETS
 - ▶ Implementation: Internet experiment and own EU-ETS account
- Target of inquiry: Impact of direct price variation on the decision *whether to contribute or not* (extensive margin)
 - ▶ Clear theoretical prediction of inverse relationship with price
 - ▶ No significant relationship in the indirect approaches and empirical literature



Research strategy

- Direct price variation in giving decisions
 - ▶ Dictator games in the lab (Andreoni and Miller, 2002; Andreoni and Vesterlund, 2001)
- Real contribution to environmental public good
- Framed field experiment
 - ▶ Control for sex, age, education, income, culture
- Control for field price censoring



Preview of results

- Significant price elasticity of probability to engage in the PEB offered
 - ▶ Price increase by € 10 decreases propensity to contribute by $\approx 1\%$
 - ▶ Elasticity of probability about 0.3
- Comparison with other covariates in the data
 - ▶ No effect of sex, age, income, or culture
 - ▶ Significant (and more elastic) effect of education



Experimental Design



Subjects and treatments

- Subjects
 - ▶ Drawn from the about 65,000 Internet panel member of German section of YouGov
 - ▶ Representative for Internet using population of German adults
- Random assignment to one of 50 treatments (experimental prices)
 - ▶ Either €2, €4, €6, ..., or €100
 - ▶ Between-subjects
- Subjects choose between this cash and the (real) 1t CO₂ mitigation
- 2,440 complete observations
 - ▶ Average of 49 subjects per price
 - ▶ Invited: 2705 (response rate: 90.2%)
- Choices implemented under lottery (between-subjects random incentive system)



Protocol

- Invitation via email through YouGov's regular system (indistinguishable from regular survey)
- Sequence of 10-13 computer screens
- Choice questions, follow-up questions, sociodemographics
- Dismissal, implementation of choices, notification via email
- Payout through YouGov's regular system
- Median completion time: 5min
- Design refined through pre-tests and pilots with Heidelberg economics students



Bei den beiden folgenden Verlosungen dürfen Sie jeweils zwischen zwei verschiedenen Gewinnen wählen. Diese sind:

Ein Bargeldgewinn in Form von Punkten

oder

die Senkung der Kohlendioxid (CO₂) - Emissionen um 1 Tonne

Wie funktioniert die Senkung der CO₂-Emissionen? Wir verwenden dazu eine zuverlässige Möglichkeit mit Hilfe des EU Emissionshandelssystems: Wir kaufen und löschen für Sie eine *EU Emissionsberechtigung*.

Emissionsberechtigungen werden in der EU von Kraftwerken und anderen großen Industrieanlagen benötigt, um CO₂ ausstoßen zu dürfen. Da es nur eine feste Anzahl von Berechtigungen gibt, stehen gelöschte Berechtigungen nicht mehr zum Ausstoß von CO₂ zur Verfügung.

Die Emissionen in Deutschland und den anderen EU-Ländern sinken durch eine gelöschte Berechtigung um genau 1 Tonne!

Durch die Art und Weise, wie sich CO₂ in der Luft verteilt, macht es dabei für die Wirkung auf das Klima keinen Unterschied, wo auf der Welt CO₂-Emissionen gesenkt werden. Es zählen nur die Gesamtemissionen weltweit. Bei den Verlosungen werden 100 Gewinner auf etwa 5.000 Teilnehmern zufällig ausgewählt. Die beiden folgenden Verlosungen können sich in den Gewinnen sowie im Auszahlungsverfahren unterscheiden.



Decision screen

In dieser Verlosung haben Sie die Wahl zwischen den beiden unten stehenden Gewinnmöglichkeiten.

- Falls Sie den Geldbetrag wählen und gewinnen, erhalten Sie in den nächsten Tagen die entsprechenden Punkte automatisch auf Ihrem Punktekonto gutgeschrieben. Alle Gewinner erhalten dazu eine kurze Benachrichtigungs-E-Mail.
- Die Löschung der Emissionsberechtigungen erfolgt in dieser Verlosung für alle Gewinner in einem Sammelauftrag: Für jeden Gewinner, der die Senkung der Emissionen gewählt hat, wird eine Emissionsberechtigung mehr gelöscht. Die Gewinner erhalten eine Benachrichtigungs-E-Mail mit einem Weblink, über den sie die Löschung auf den Internetseiten der Universität Heidelberg zuverlässig nachvollziehen können.

Bitte wählen Sie nun aus, welchen Preis Sie in dieser Verlosung möchten, falls Sie als Gewinner gezogen werden:

- Die Senkung der CO₂-Emissionen um 1 Tonne durch Löschen einer EU Emissionsberechtigung
- 46 Euro in Form von Bonuspunkten

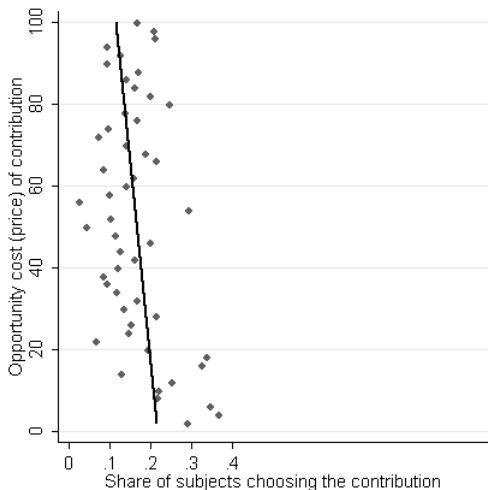


Results



Descriptive results

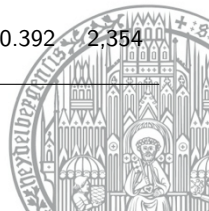
- Out of 2,440 subjects
 - ▶ 382 chose the GHG emissions reduction
 - ▶ 2058 chose the cash
 - ▶ 86 expressed reservations about realism (and were excluded)
- Contribution rate 16.2%



Summary statistics

Table: Summary statistics of sample sociodemographics

Variable	Description	Mean	SD	N
Female	Indicator variable for gender	0.469	0.499	2,354
Age	Subject's age (years)	45.42	14.68	2,352
Education	Years of education based on subject's highest educational degree	12.27	3.213	2,299
Income	Midpoint of subject's monthly household net income category (in thousand €)	2.556	1.706	1,950
East Germany	Indicator variable for residence on former GDR territory	0.190	0.392	2,354



Probit regression results

	(1)	(2)	(3)	(4)
Price (1 unit=€ 10)	-0.0093*** (0.003)	-0.0541*** (0.010)	-0.0094*** (0.003)	-0.0531*** (0.011)
Price squared	-	0.0045*** (0.001)	-	0.0044*** (0.001)
Female	-	-	0.0223 (0.018)	0.0215 (0.018)
Age	-	-	0.0009 (0.001)	0.0008 (0.001)
Education	-	-	0.0150*** (0.003)	0.0148*** (0.003)
Income (1 unit=€ 1,000)	-	-	-0.0060 (0.005)	-0.0059 (0.005)
East Germany	-	-	-0.0246 (0.021)	-0.0233 (0.021)
Additional controls	No	No	Yes	Yes
N	2354	2354	1872	1872
Log-likelihood	-1037.451	-1027.442	-786.483	-778.666
Pseudo R ²	0.006	0.016	0.049	0.059

Notes: Additional controls include dummies for experimental session, day, and daytime.

Headline results: Price effect

Price (1 unit=€ 10)	-0.0093*** (0.003)	-0.0541*** (0.010)	-0.0094*** (0.003)	-0.0531*** (0.011)
Price squared	-	0.0045*** (0.001)	-	0.0044*** (0.001)

- Price decrease of € 1 increases propensity to contribute by $\approx 0.1\%$
- Elasticity around -0.3 (S.E. 0.1)
 - ▶ Recovers theoretical prediction vis-a-vis previous literature
 - ▶ Inelastic response
- Evidence for some non-linearity



Headline results: Sociodemographics

Female	-	(0.002)	0.0223	0.0215
			(0.018)	(0.018)
Age	-	-	0.0009	0.0008
			(0.001)	(0.001)
Education	-	-	0.0150***	0.0148***
			(0.003)	(0.003)
Income (1 unit=€1,000)	-	-	-0.0060	-0.0059
			(0.005)	(0.005)
East Germany	-	-	-0.0246	-0.0233
			(0.021)	(0.021)

- No evidence for “young, selfish, and male” (List 2004)
- Education significant driver of the choice
 - ▶ Elasticity about 1.2
 - ▶ Given the variation in the sample, education affects choice more than prices
- Income not significant (bias from self-reporting?)



Conclusions

- Starting point: Does the price of PEB influence the decision to engage in PEB?
 - ▶ Theory: Yes.
 - ▶ Experimental evidence so far: No.
- Problem with experimental evidence: Indirect price variation
- Here: Direct price variation in large-scale framed field experiment using (real) mitigation of 1t CO₂ via EU-ETS
- Finding: Theory is right. Making PEB cheaper makes more people contribute
 - ▶ But: response inelastic (≈ 0.3)
 - ▶ In contrast, education has elastic response (≈ 1.2)
- Implications?
 - ▶ Regarding extensive margin, subsidizing PEB may be ill-advised
 - ▶ Improving education may affect PEB more (but need to know marginal impact of subsidies on education)



Thank you.

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