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des Transports

Mobility choices and climate change: which incentives are effective?

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Context and motivation

- Role of transport activity in GHG emissions
  - Both technology *and* behavior change needed to reach ambitious targets of emission reduction
- Carbon taxes (CT) recognized as the most cost-effective instruments, but issue of acceptability
- Alternative instrument such as Personal Carbon Trading (PCT): are they more effective?
- Influences devised from social psychology may perform as well (water, energy, waste…)
- What about social norms in influencing mobility choices?

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Would personal carbon trading be more effective than a carbon tax in reducing travel emissions? Results of a stated preferences study

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Stated preferences study

- Selection of surveyed persons (June-July 2009), Lyon's area (city centre + suburban shopping malls): N = 788
  - face-to-face short interview in order to record their mobility (car and plane) = the "fact base"
- Design of SP survey: attributes and scenarios, pilot study (Sep.-Dec. 2009)
  - each choice situation: 3 options (2 reductions of trips, 3rd one no change and pay)
- Paper + telephone survey (Jan.-Feb. 2010)
- N = 268 individuals ("clean" questionnaires)

Logit model, remaining kms travelled

	Overall				PCT				CT		
	Estimate	t-value	Pr(>|t|)		Estimate	t-value	Pr(>|t|)		Estimate	t-value	Pr(>|t|)
alt2	0.156	1.878	0.060	.	0.301	2.482	0.013	*	0.037	0.322	0.747
alt3	0.412	4.305	0.000	***	0.580	4.076	0.000	***	0.247	1.841	0.066
net.inc	0.907	2.594	0.009	**	1.358	3.055	0.002	**	0.054	0.090	0.928
km	0.094	2.590	0.010	**	0.133	2.810	0.005	**	0.021	0.353	0.724
Log-Likelihood	-1073.4				-517.32				-552.9		
McFadden R^2:	0.003				0.010				0.001		
LR test : chisq	7.336				10.221				0.557		
p.value	0.026				0.006				0.757		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Overall results

- Evidence that PCT could change travel behavior
- but people tend to protect long and very long distance trips (week-end and holiday trips)
- Preference for status quo
- no significant difference in effectiveness between CT and PCT
- CT trade-offs: erratic, non significant estimates
- Perspectives: what are the respective roles of social norm (carbon budgeting) and economic sanction?... Psycho-economic experiments?

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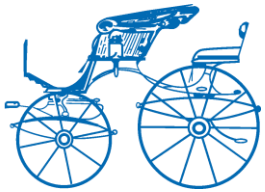

Mobility choices and climate change: assessing the effects of social norms and economic incentives through discrete choice experiments

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Context and motivation

- Influences devised from social psychology may perform as well (water, energy, waste…)
- What about transport/mobility choices?
- Aim: evaluate and compare the impacts of social norms and economic incentives when encouraging pro-environmental mobility behavior

Methodology

- Elicit individual's preferences in a (hypothetical) context
  - Stated Choice (SC) Methods: Discrete Choice Experiments (DCE) rooted in Random Utility Theory
- Field experiment: long distance leisure travel
  - large quantity of emissions, can be split from routine (daily) travel behavior
- Trade-off between travel price and travel time under various framing conditions (social norms and economic incentives)
- No interaction between individuals, survey through an internet panel

Which alternatives and attributes?

- One week stay at destination (~1000 km)
  - one week: make ground transportation a plausible alternative (time)
  - for 2 people: make private car a plausible alternative (price)
- Alternatives: air, car, coach, train, no travel at all
- Attributes:
  - price, travel time + various framings
  - price: 400 to 700 € (return price for 2 people)
  - travel time: air = 3h to 10h (with connections), car and coach = 10h to 17h, train = 5h (HST) to 17h
- S-efficient design (Rose and Bliemer, 2005, 2013)

Overall study

- Framing conditions:
  1. no CO2 information (N=300) “control condition”
  2. information on CO2 for each mode (emissions amount)
  3. information on CO2 + injunctive norm,
  4. information on CO2 + injunctive + descriptive norm
  5. information on CO2 + injunctive norm + tax
  6. information on CO2 + injunctive norm + bonus-malus
  7. information on CO2 + injunctive norm + quota
- 7 different samples
  - 1st N=300 then N=100, from June 2013 to June 2014
  - quotas: gender x age, job status household, urban area (8 main French airports)

Conditions with social norms

- Injunctive norm (IN)
  - "The high level of greenhouse gas emissions in the atmosphere (such as CO_2) can cause dangerous climate change for the planet. Climatologists are already seeing many consequences such as melting glaciers or ice field. According to scientists, to limit these effects it is necessary that all humans reduce their emissions by half."
- Descriptive norm (DN)
  - "60% of French people personally contribute through their daily actions to reduce their emissions"

Control condition

Model	MNL
Variables	
Air constant	6.9581*** (0.2639)
Car constant	5.8668*** (0.3380)
Coach constant	4.4862*** (0.6489)
Train constant	7.0324*** (0.2739)
Price	-0.0059*** (0.0004)
Air duration	-0.2435*** (0.0192)
Car duration	-0.1400*** (0.0219)
Coach duration	-0.1781*** (0.0538)
Train duration	-0.2631*** (0.0175)
N	1758
Log-likelihood	-1724
ρ^2 McFadden	0.3908
Estrella indicator	0.7937
Values of time	
Air	41 €
Car	24 €
Coach	30 €
Train	45 €

- Preference for travelling
- Values of time per mode "in line" with observed behaviour
- Gender, age, income not significant

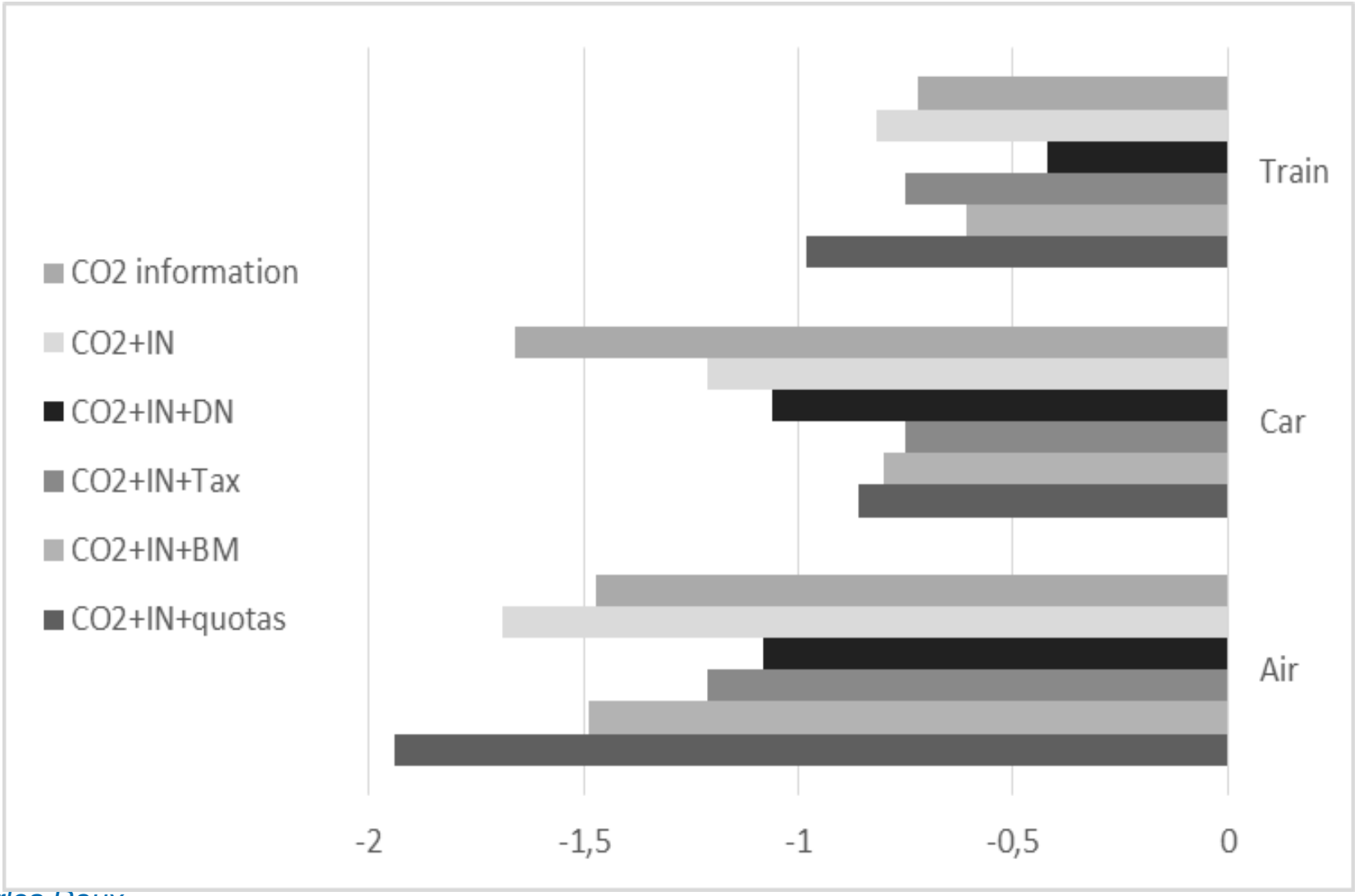
The "renouncing travel" alternative is the reference
Standard deviation in parenthesis
****: significant at 1%; **: significant at 5%; *: significant at 10%*

All conditions (1 to 7)

Variables	Coefficients	
Air constant	2.1475***	(0.2806)
Car constant	1.6075***	(0.3141)
Train constant	2.0954***	(0.2868)
Price	-0.0052***	(0.0002)
Air duration	-0.2103***	(0.0112)
Car duration	-0.1640***	(0.0123)
Coach duration	-0.1844***	(0.0201)
Train duration	-0.2224***	(0.0085)
Air-CO2	-1.4720***	(0.2086)
Car-CO2	-1.6591***	(0.2471)
Train-CO2	-0.7244***	(0.2199)
Air- CO2+ IN	-1.6922***	(0.2096)
Car- CO2+IN	-1.2077***	(0.2328)
Train- CO2+IN	-0.8163***	(0.2200)
Air- CO2+ IN +DN	-1.0749***	(0.2157)
Car- CO2+ IN +DN	-1.0618***	(0.2453)
Train- CO2+ IN +DN	-0.4218*	(0.2278)
Air- CO2+ IN +Tax	-1.2101***	(0.2398)
Car- CO2+ IN +Tax	-0.7487***	(0.2567)
Train-CO2+IN+Tax	-0.7524***	(0.2491)
Air- CO2+ IN +BM	-1.4853***	(0.2364)
Car- CO2+ IN +BM	-0.8005***	(0.2566)
Train- CO2+ IN +BM	-0.6117***	(0.2468)
Air- CO2+ IN +Quota	-1.9396***	(0.2250)
Car- CO2+ IN +Quota	-0.8576***	(0.2414)
Train- CO2+ IN +Quota	-0.9780***	(0.2352)
N	5010	
Log-likelihood	-4963	
ρ^2 McFadden	0.2854	
Estrella indicator	0.6003	

The "coach" alternative is the reference
Standard deviation in parenthesis
****: significant at 1%; **: significant at 5%; *: significant at 10%*

Comparison of framing effects



Role of framing effect

Variables	Including tax framing effect	Excluding tax framing effect
Air constant	2.6309*** (0.3543)	2.6614*** (0.3475)
Car constant	2.0877*** (0.3962)	2.1523*** (0.3894)
Train constant	2.6265*** (0.3586)	2.6857*** (0.3505)
Baseline price	-0.0055*** (0.0002)	-0.0055*** (0.0002)
Amount of carbon tax	-0.0014 (0.0062)	-0.0187*** (0.0031)
Air duration	-0.2302*** (0.0139)	-0.2293*** (0.0139)
Car duration	-0.1748*** (0.0155)	-0.1729*** (0.0154)
Coach duration	-0.1548*** (0.0264)	-0.1329*** (0.0251)
Train duration	-0.2429*** (0.0110)	-0.2440*** (0.0109)
Air-CO_2	-1.4519*** (0.2092)	-1.2417*** (0.1891)
Car-CO_2	-1.6304*** (0.2480)	-1.4769*** (0.2271)
Train-CO_2	-0.6648*** (0.2221)	-0.4671** (0.1983)
Air- CO_{2+}IN	-1.6737*** (0.2101)	-1.4626*** (0.1900)
Car- CO_{2+}IN	-1.1739*** (0.2338)	-1.0200*** (0.2113)
Train- CO_{2+}IN	-0.7549*** (0.2222)	-0.5565*** (0.1984)
Air- CO_{2+}IN+Tax	-1.3077*** (0.3358)	
Car- CO_{2+}IN+Tax	-0.7860*** (0.2849)	
Train-CO_{2+}IN+Tax	-0.6883*** (0.2552)	
N	3313	3313
Log-likelihood	-3166	-3174
ρ^2 McFadden	0.3106	0.3088

Discussion

- Signs of the coefficients and stated VOTT show empirical consistency of the survey
- Framing effects are significant for each travel mode
- CO2 information highly effective on its own
- Injunctive norm: reinforced effect for air and train
- Descriptive norm or fiscal framing look counterproductive
- Quotas > Bonus-malus > Tax effect
- No effect of economic sanction or reward amount, but effect of the fiscal framing itself

Overall conclusion

- No difference in effectiveness between CT and PCT when considering all modes
- Psycho-social norms are effective on their own in changing (stated) travel behavior
- Providing basic information on CO2 emissions for each alternative may actually influence choices
- Normative messages through benchmarking (bonus-malus) or carbon budgeting (quotas) may reinforce the incentive. Esp. for air
- Fiscal framing: the amount of the financial (dis)incentive in itself might not matter

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Attributes of “car travel” scenarios

- Five attributes regarding distance = categories…

very short distance	from 0 to 10 km
short distance	from 10 to 20 km
average distance	from 20 to 60 km
long distance	from 60 to 300 km
very long distance	over 300 km

- … with four levels each: 0%, -15%, -30%, -45%
- choice expressed as trip suppressions

Attributes of “car travel” scenarios (cont’)

- Instrument type: tax or personal carbon allowance
- Allocation of “free” consumption (i.e. carbon tax-free consumption or allowances): current consumption, -20%, -30%, -40%
- “Price”: carbon tax or price of additional allowance (€/liter): 0.1, 0.4, 0.7, 1

- Each individual is submitted to 4 “car” scenarios

269

Points

Payant à partir de :	**416 litres**
Prix du litre supplémentaire :	**0,7 €**

SCENARIO 3

	Option 1	Option 2	Option 3…
	Je n'utilise plus ma voiture pour : …	**Je n'utilise plus ma voiture pour : …**	
	… **201** déplacement(s) très courte distance **par an** *~ 4 - semaine*	… **302** déplacement(s) très courte distance **par an** *~ 5 - semaine*	- Je ne change rien et je **j'achète** des points pour une valeur de **104 €** par an.
			
		… **et 21** déplacement(s) moyenne distance **par an** *~ 2 # mois*	
			
			
	… et je **rachète** des points pour une valeur de **23 €**	… et je **revends** des points pour une valeur de **-130 €**	

Model

- Discrete Choice Model: Multinomial logit (MNL)
- Only main effects, no interaction effects
- Sketch utility function

U(alt) = b0 + b1 * prix + b2 * duration + bn * effects

Issues in SC design

- Full factorial design (not feasible), orthogonal designs (suited to linear models, not to DCM)
- Efficient design: aims at generating parameters with as small as possible standard errors
  - based on the underlying experiment and DC model and some prior information on parameters
- Allows reduction of the sample size N and the number of choices S presented
- Efficiency increased when the less attribute levels and the wider the range of attribute levels

Phasing the waves

- Wave 1: condition1 (control condition), June 2013, N=300
  - quotas: gender x age, job status household, urban area (main French airports)
- Wave 2: conditions 2, 3, 4, December 2013, N=100 in each condition (S-efficient design), same quotas
- Wave 3: conditions 5, 6, 7, June 2014, N=100 in each condition (S-efficient design), same quotas

Example of choice situation displayed

You travel with another person to a destination of your choice, located 1,000 km from home.
Here is a first transport situation that is offered to you:

	Air	Coach	Car*	Train
Duration (one way) **	10h	17h	17h	10h
Price (return for two persons)	600 €	600 €	400 €	400 €
CO_2 emitted (return for two persons)	720 kg	124 kg	408 kg	180 kg
Threshold level (kg of CO_2)	150 kg	150 kg	150 kg	150 kg
Unit amount bonus/malus per kg of CO_2	0.05 €	0.05 €	0.05 €	0.05 €
Total bonus (price increase) or malus (price decrease)	29 €	-1 €	13 €	2 €
Total price (including bonus/malus)	629 €	599 €	413 €	402 €

Based on these informations, and not taking account of your previous answers, what means of transportation do you choose? You also have the choice of renouncing travel.