Lecture 3.a: Instrument choice: behavioral policies.

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- To a large extent, this assumption is useful and allows to derive critical policy implications (see previous lectures).

- However, still important to relax this assumption and assess what deviations from this form of rationality imply for policies.

- Example of deviations:
  - (imperfect) altruism;
  - social image concerns;
  - inattention to prices;
  - internalities (*e.g.*, non internalized health benefits);
  - present bias;
  - loss-aversion;
  - mis-perception of probabilities / orders of magnitude;
  - motivated reasoning;
  - etc.

(Note: some of the above can be rationalized, but they still imply deviations from standard models).

Implications for climate policies

Limits to rationality and other forms of deviations from the standard framework have implications for:

1. the effectiveness of policies;
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$\rightarrow$ Today, focus on the first aspect. Tomorrow, look at the second.

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Many ways to investigate the topic. In this lecture, no systematic framework, we will proceed through specific examples.

Road map

1. Social image concerns
2. Present bias
3. Lack of attention or awareness
4. Motivated reasoning

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Conformism and descriptive norms

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- As a result, they may be sensitive to social norms:
  - descriptive norms: what people generally do, description of what *is*.
  - injunctive (a.k.a. prescriptive) norms: what people approve or disapprove, description of what *ought to be*.

- Can these norms be leveraged as policy tools for the climate?

→ Case study: the OPOWER program on households' energy consumption (Allcott, 2011; Allcott & Rogers, 2014; Allcott & Kessler, 2019).

The OPOWER program

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- OPOWER sends reports to households with:
  - information on their consumption relative to neighbors with similar characteristics (*i.e.*, the norm);
  - advices on how to reduce their energy consumption.
- Population randomized into a Treatment group which receives the report, and a Control group which does not.
- Reports are sent on a regular basis (every month, every two months, or every quarter).

Social comparison

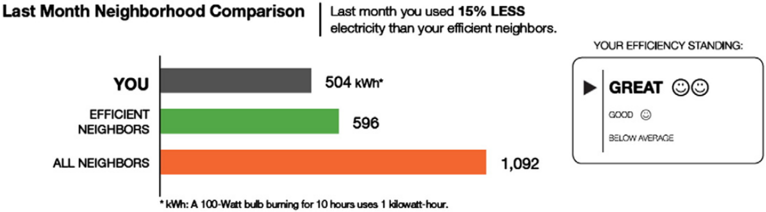

Fig. 1. Home energy reports: social comparison module.

Social comparison

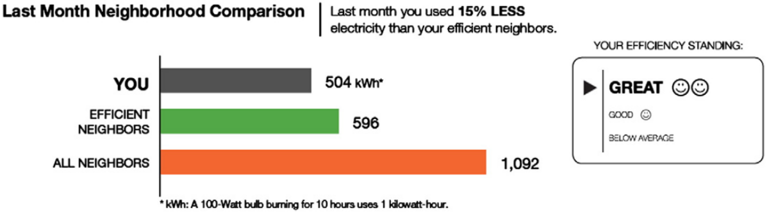

Fig. 1. Home energy reports: social comparison module.

→ Comparison on the left: descriptive norm. Smileys on the right: injunctive norm.

Energy conservation advice

Action Steps | **Personalized tips chosen for you based on your energy use and housing profile**

Quick Fixes
Things you can do right now

☐ **Adjust the display on your TV**
New televisions are originally configured to look best on the showroom floor—at a setting that's generally unnecessary for your home.

Changing your TV's display settings can reduce its power use by up to 50% without compromising picture quality. Use the "display" or "picture" menus on your TV: adjusting the "contrast" and "brightness" settings have the most impact on energy use.

Dimming the display can also extend the life of your television.

SAVE UP TO
$40 PER TV PER YEAR

Smart Purchases
Save a lot by spending a little

☐ **Install occupancy sensors**
Have trouble remembering to turn the lights off? Occupancy sensors automatically switch them off once you leave a room—saving you worry and money.

Sensors are ideal for rooms people enter and leave frequently (such as a family room) and also areas where a light would not be seen (such as a storage area).

Wall-mounted models replace standard light switches and they are available at most hardware stores.

SAVE UP TO
$30 PER YEAR

Great Investments
Big ideas for big savings

☐ **Save money with a new clothes washer**
Washing your clothes in a machine uses significant energy, especially if you use warm or hot water cycles.

In fact, when using warm or hot cycles, up to 90% of the total energy used for washing clothes goes towards water heating.

Some premium-efficiency clothes washers use about half the water of older models, which means you save money. SMUD offers a rebate on certain washers—visit our website for more details.

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Fig. 2. Home energy reports: action steps module.

Average electricity use by U.S. households

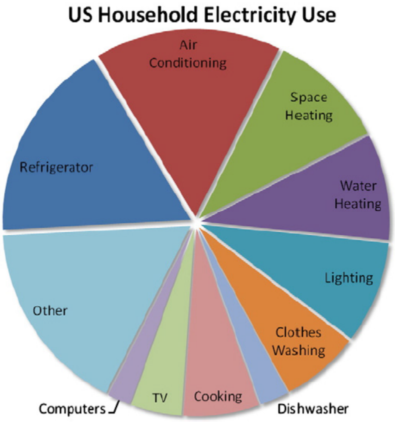

Fig. 3. US household electricity use.

Empirical problem

- Objective: estimate the effect of receiving the report on energy consumption;
- The authors want to obtain $\tau = \mathbf{E}[Y_{i,t}(1) - Y_{i,t}(0)]$, with:
  - $Y_{i,t}(1)$: consumption of household i at that t if this household received the report;
  - $Y_{i,t}(0)$: consumption of household i at that t if this household *did not* received the report.

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- Problem: $Y_{i,t}(1)$ and $Y_{i,t}(0)$ are never simultaneously observed.

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  - Example: those consuming more could be more likely to opt-out, hence treated households would consume less on average even absent the treatment.

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- Method 2: compare households consumption before and after receiving the report.
  - Problem: their consumption could have changed for other reasons (*e.g.*, different season hence different temperatures).
- Method 3: compound these two differences, *i.e.* compare households who received *vs* did not receive the treatment, before and after the treatment.

$\rightarrow$ The authors use this third method, the difference-in-difference method.

Implementing the method

Formally, the previous methods lead to estimate the following regressions:

- Method 1:

$$Y_{i,t} = \alpha_0 + \alpha_1 T_i + \epsilon_{i,t}$$

- Method 2:

$$Y_{i,t} = \beta + \beta_1 P_t + \epsilon_{i,t}$$

- Method 3:

$$Y_{i,t} = \gamma_0 + \gamma_1 T_i + \gamma_2 P_t + \gamma_3 T_i \times P_t + \epsilon_{i,t}$$

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Following the diff-in-diff approach (*i.e.* method 3), $\hat{\gamma}_3$ gives an estimate of τ, the effect of the reports.

N.B.: the previous regressions can be estimated with OLS. In addition, control variables and time and household fixed effects can be added.

Results: average treatment effect for experimenter Connexus

Table 3
Connexus ATE specifications.

	I	II	III	IV	V
T × Monthly × Post	−2.65	−2.72	−2.72	−2.69	−2.74
	(0.27)	(0.18)	(0.18)	(0.16)	(0.18)
T × Quarterly × Post	−2.46	−2.26	−2.26	−2.23	−2.26
	(0.37)	(0.21)	(0.21)	(0.18)	(0.21)
Post	−3.70	−5.82	−2.41	−5.04	−0.63
	(0.12)	(0.11)	(0.46)	(0.36)	(0.46)
T	0.19				
	(0.40)				
Degree-day bins	No	No	No	No	Yes
Month × Year dummies	No	No	Yes	Yes	Yes
House fixed effects	No	Yes	Yes	No	Yes
House × Month fixed effects	No	No	No	Yes	No
Observations (thousands)	3421	3421	3421	3421	3421
R^2	0.0016	0.0016	0.0586	0.0000	0.0651
F statistic	874	2868	4643	3564	

Standard errors in parentheses. Dependent variable is the household's average daily electricity consumption (kilowatt-hours), normalized by average control group consumption in the Post period.

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→ Average treatment effect: the program reduces consumption by about 2.5% for Connexus (experimenter 4).

Results: average treatment effect from all experimenters

Table 4
ATEs for all experiments.

Experiment	ATEs (%)		
Number	Monthly	BiMonthly	Quarterly
1	Non-Exper	–	–
2	−1.83 (0.20)	–	–
3	–	−1.40 (0.19)	−1.37 (0.19)
4	−2.72 (0.18)	–	−2.26 (0.21)
5	–	−2.70 (0.44)	–
6	–	–	−1.64 (0.33)
7	–	−2.48 (0.25)	–
8	–	−3.32 (0.54)	–
9	–	−1.63 (0.15)	–
10	Non-Exper	–	–
11	−1.96 (0.14)	–	−1.49 (0.20)
12	−1.39 (0.34)	–	–
13	–	–	−1.44 (0.51)
14	–	Non-Exper	–
15	–	−1.89 (0.21)	–
16	−3.14 (0.37)	–	–
17	–	–	−1.84 (0.43)
Mean ATE	−2.03		

→ Average treatment effect: the program reduces consumption by about 2% on average.

Heterogeneous treatment effects

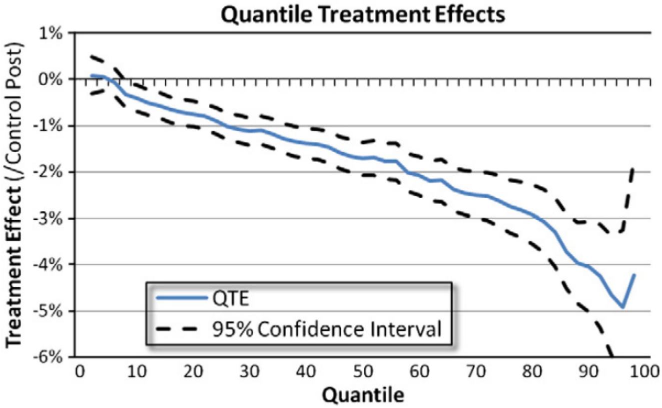

Fig. 7. Quantile treatment effects.

→ Stronger effect for those initially consuming more + no backfire effect for those initially consuming less.

Results: persistence over time

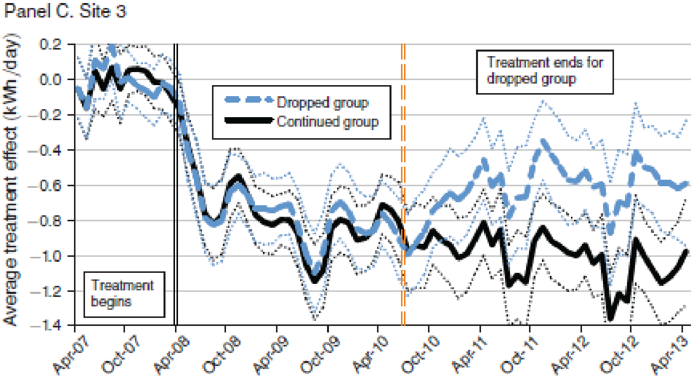

Figure 4. Long-Run Effects

Notes: These figures plot the ATEs for each month of the sample for the continued and dropped groups, estimated by equation (5). The dotted lines reflect 90 percent confidence intervals, with robust standard errors clustered by household in Sites 1 and 2 and by block batch in Site 3.

→ Blue group ceases the treatment after orange bar period: effect of the treatment attenuates but remains significant after several years.

The welfare cost of nudges

- Allcott (2011): effect of the reports equivalent to a short-run electricity price increase of 11% to 20%.
- *A priori*, this energy conservation is achieved at a very low cost.
- However, nudges have hidden costs. Glaeser (2006): nudges are emotional taxes, reduce utility but no revenue collected.
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- For a comprehensive cost-benefit analysis, need to account for the side-effects of nudges.
- Allcott and Kessler (2019): evaluate willingness to pay (WTP) for receiving reports one more year.
- They find WTP equivalent to 57% of expected energy cost savings $\rightarrow$ conclude that 43% of cost savings compensated by financial, time, comfort, and psychological costs from the program.

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Energy consumption as an inter-temporal problem

- Individuals' energy consumption often results from two-stage decision process:
  - which energy-consuming appliance do I choose?
  - How much do I use this appliance?
- Examples:
  - do I buy a small energy-efficient car or a 2 tons SUV? Then, how many kilometers do I drive?
  - Do I buy expensive but efficient light-bulbs? Or cheap but inefficient ones?

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- Rational self-interested individuals: choose the option that delivers the highest inter-temporal payoff.
- Problem: What if individuals do not properly account for their own future welfare?
  - Example: present biased consumers might go for what is cheap today, and regret it later.

Solutions to correct these biases?

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- Generate salient information on cost savings.
  - Example: use colors (green, ..., red) or letters (A, B, C, etc.) to indicate energy efficiency of a fridge.

- Tax/subsidize dirty/clean durable goods.
  - Example: impose a bonus/malus to cars depending on their energy efficiency $\rightarrow$ moves discounted future energy prices to the present.

- Impose a ban on less efficient technologies.
  - Example: simply forbid the least efficient light bulbs.

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When individuals are not fully rational, no general result about which policy is better. Determined case by case.

Taxing durables: an example

- In January 2008, France introduced a bonus/malus policy: the purchase of a new vehicle was subsidized (up to 1000€) or taxed (up to 2600€) depending on its CO_2 emissions.
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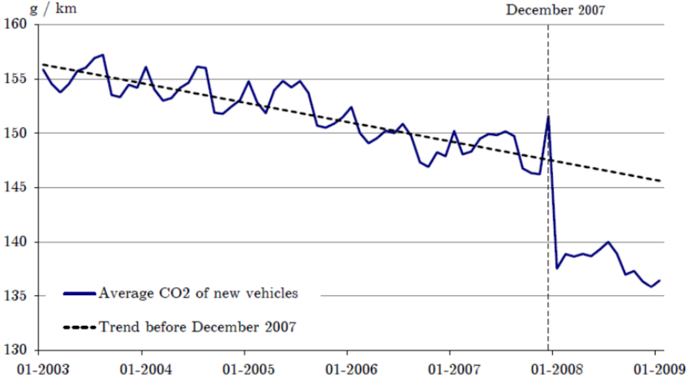
- Objective of the policy: incentivize customers to account for their future emissions.
    - Complementary to fuel taxes, especially if consumers discount future costs.
- Did it work?
    - Mixed results!
    - On the one hand: consumers clearly switched to cleaner vehicles.
    - On the other hand: the bonus lead an increase in vehicles' purchases (number of car purchased went up by around 13%), and many adjustments were made at the margin (from a car just above to just below the emission threshold).
    - The policy represented a net cost for the government, and aggregate emissions were estimated to go up (at least in he short run) because of higher emissions from manufacturing new vehicles.



Sources : dataset on the registration of new cars (CCFA).

Fig. 2: Evolution of the Average CO_2 Emissions of New Cars

Source: D'Haultfoeuille et al, 2014.

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Attention to prices

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- Runs a survey, ask people to precisely compute their expected fuel costs;
- Then, ask the following:

  "In this survey, we asked you to calculate fuel costs fairly mathematically and precisely. Think back to the time when you were deciding whether to purchase your vehicle. At that time, how precisely did you calculate the potential fuel costs for your vehicle and other vehicles you could have bought?"
- Five possible responses from *"I did not think about fuel costs at all when making my decision"* to *"I calculated more precisely than I did just now during this survey."*

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- Five possible responses from *"I did not think about fuel costs at all when making my decision"* to *"I calculated more precisely than I did just now during this survey."*
- 40% did not think of it at all; 89% though of it less precisely.

Table 3 Correlates of fuel cost calculation effort

	(1)	(2)
Gas price at purchase ($/gallon)	0.148 (0.046)***	−0.801 (0.431)*
ln(Implied miles/year)	0.069 (0.034)**	−0.205 (0.124)*
Environmentalist	0.254 (0.115)**	0.251 (0.115)**
Income ($ millions)	0.201 (0.859)	0.216 (0.860)
Education (years)	0.051 (0.015)***	0.052 (0.015)***
Age	−0.006 (0.002)**	−0.006 (0.002)***
1(Male)	0.211 (0.070)***	0.204 (0.070)***
1(Rural)	−0.132 (0.082)	−0.137 (0.083)*
Gas price × ln(Implied miles/year)		0.106 (0.049)**
N	1,444	1,444

The dependent variable is a measure of fuel cost calculation effort from the Vehicle Ownership and Alternatives Survey, normalized to a standard deviation of 1. Gas price at purchase is the US average retail gasoline price in the month that the vehicle was purchased from the US Energy Information Administration, inflated to 2014 dollars. Implied miles/year is backed out from self-reported gasoline expenditures using the current vehicle MPG rating and gasoline prices. Environmentalist is the consumer's response to the question, "Would you describe yourself as an environmentalist?" "Yes, definitely," "Yes, somewhat," and "No" are coded as 1, 1/2, and 0, respectively. Robust standard errors are in parentheses. *, **, and *** denote statistically different from zero with 90%, 95%, and 99% confidence, respectively.

Endogenous attention

- Column 1:
  - people who drive more make on average higher calculation efforts;
  - when gasoline prices were higher at the time of the purchasing decision, consumers also made higher efforts on average.

- Column 2:
  - similar regression, with additional interaction term for gasoline price $\times$ distance traveled included;
  - the coefficient is positive and statistically significant.

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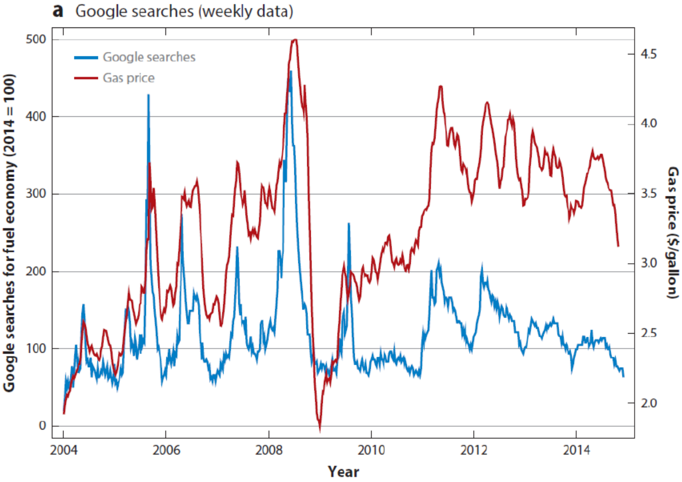
  - similar regression, with additional interaction term for gasoline price $\times$ distance traveled included;
  - the coefficient is positive and statistically significant.

- Simple correlations, but consistent with endogenous attention: the more relevant are energy prices for their purchasing decision, the more efforts they make to get the calculation right.

Daily Google search for “fuel economy” as a function of gas prices



Daily number of visit on the website fueleconomy.gov as a function of gas prices

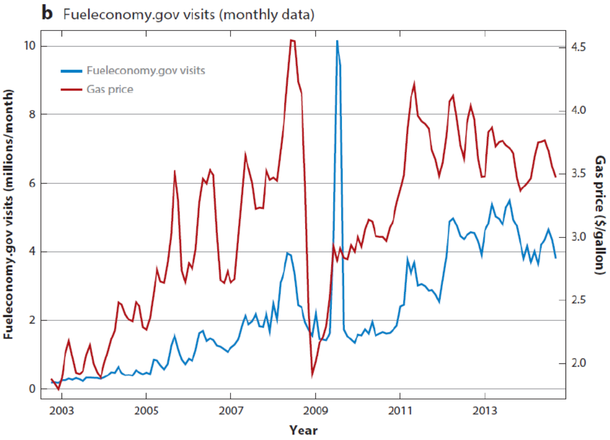


Figure 4

Gasoline prices and search volume. In panel *a*, Google searches represent the relative popularity of five fuel economy-related search terms (gas mileage, fuel economy, miles per gallon, fuel efficiency, and mileage calculator) from Google Trends data. In panel *b*, fueleconomy.gov visits represent unique sessions as defined by Google Analytics. Gas price is the "US All Grades All Formulations Retail Gasoline Price" from the US Energy Information Administration.

Implications for policies

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- Low prices: limited attention, may lead to inefficient decisions.
- Implication for energy taxes: potential multiplier effect $\rightarrow$ indirectly provides information on top of the price effect.
- Public support to energy taxes might also depend on prices: taxes not salient as long as prices remain low.
  - Example: Yellow Vests movement in France $\rightarrow$ carbon tax implemented in 2014, no opposition until oil prices spike in 2018 (see next lecture).

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Conflicting objectives

- Many actions we do generate negative externalities.
- Examples in climate change context:
  - traveling by plane;
  - heating house at 22°C in the winter;
  - eating beef;
  - etc.
- Such behaviors not surprising from self-interested rational individuals.
- But individuals generally care about others and have moral concerns.
- How do consumers reconcile the two?

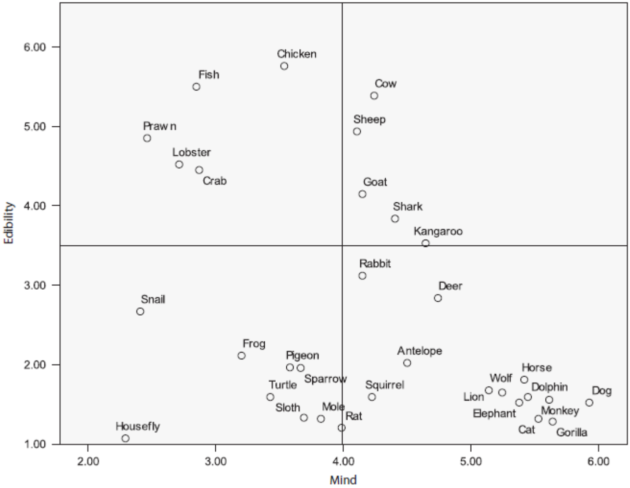
The “meat paradox”

$\rightarrow$ Hestermann et al (2020) study this theoretically through the case of meat consumption.

- A lot of people enjoy eating meat;
- at the same time, they care about animal welfare;
- how do they deal with the moral cost of their action?

They build a model in which people have two selves, and lie to themselves.

Some suggestive empirical evidence



→ Humans often tend to underestimate the mind of species they eat. Some causal evidence in the lab (see Bastian et al, 2012).

A model of the "meat paradox" (1/2)

Slightly simplified version of the model:

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- Self-1:
  - enjoys utility $U(c) - pc$ from consuming a quantity c of meat at price p.
  - In addition, faces a moral cost $\omega\tilde{x}c$ where ω is how much they care about animals, and $\tilde{x}$ their beliefs about animals' suffering.
  - The problem of Self-1 is thus:

    $$\max_{c \in R_+} U(c) - pc - \omega\tilde{x}c$$

    so that at the optimum:

    $$c^*(\tilde{x}) = \{(U')^{-1}(p + \omega\tilde{x}); 0\}$$

  - Hence, the higher p, ω, or $\tilde{x}$, the less meat will Self-1 consume.

A model of the "meat paradox" (2/2)

- Self-0:
  - maximizes the same utility as Self-1;
  - receives a signal about the true value of x: x_H (resp. x_L means animals suffering is high (resp. low);
  - can choose to incur a "self-deception" cost κ to lie to its future self (Self-1) and report x_L instead of x_H.

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- Equilibrium results:
  - people with higher preference for meat are more prone to self-deception;
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$\rightarrow$ Underscores the potential of taxes. Information provision could also be effective in the long-run (with repeated exposure, cost of self-deception becomes high).

Conclusion

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Tomorrow: again look at imperfect rationality, but we move away from efficiency concerns. Focus on how individuals' perceptions affect their support for climate policies.