COOPERATION IN A COLLECTIVE SOCIAL DILEMMA

Anna-Mateja Delas

Experimental Design Proposal

UTS 2017

DISPOSITION

- Introduction
- Related literature
- Motivation
- Experimental design
- Predictions
- Questions & discussion

INTRO - EVIDENCE FROM THE FIELD

- climate change is stated to be the most complicated environmental problem society has ever faced
  - large asymmetry between countries (economic development, historical emissions)
  - future damages cannot be well predicted, uncertainty
  - $\pi_i = B(e_i) - e(a_i) - D(E)$ (global emissions game)
  - in GT often modelled as PD dilemma with additional features of a coordination game
- so far climate negotiations, organised by the United Nations Framework Convention on Climate Change (UNFCCC), in a large group have not achieved much by tackling climate change
  - CoP in Paris 2015 massive failure
  - Kyoto Protocol: doomed from the start since not enough ‚economic glue' to hold a cooperative coalition together
- nowadays it can be observed that in negotiations in smaller circles - think of consisting of like-minded coalitions and players only - come up with stricter emission abatement (conditional/unconditional targets)

RELATED LITERATURE I/II

- group composition and cooperation
  - Burlando & Guala (EE, 2005) - heterogeneous agents in public goods experiments
  - Gächter & Thöni (JEEA, 2005) - social learning and voluntary cooperation among like-minded people
- conditional cooperation
  - Levine (RED, 1998) - modeling altruism and spitefulness in economic experiments …"individuals are more altruistic if they know that their counterparts are altruistic"
  - Fischbacher et al. (EL, 2001) - are people conditionally cooperative?
  - Fischbacher & Gächter (AER, 2010) - social preferences, beliefs, and the dynamics of free-riding in PG experiments
- collective-risk social dilemma games (public goods games with a threshold, no social marginal return, and probability to lose all if threshold after last round is not achieved in group)
  - Milinski et al. (PNAS, 2008) - the collective-risk social dilemma and the prevention of simulated dangerous climate change
  - Tavoni (PNAS, 2011) - inequality, communication, and the avoidance of disastrous climate change in public goods games

RELATED LITERATURE II/II

- climate clubs
  - Victor (UNFCCC paper, 2015) - the case for climate clubs
  - Nordhaus (AER, 2015) - climate clubs: overcoming free-riding in international climate policy
      - IAM, simulations
      - settles on an evolutionary algorithm to find stable coalitions
  - Biermann et al. (GEP, 2009) - the fragmentation of global governance architectures: a framework for analysis
      - ...list 4 types of benefits that derive from using clubs, i.e. speed (faster negotiators), ambition ("narrow but deep" vs. "broad but shallow"), participation (fewer barriers), equity ("regional" solutions)
- coalitions
  - Desslar & Parson (Cambridge Uni Press, 2010) - the science and politics of global climate change …"coalition of the willing"

MOTIVATION & QUESTION HOPED TO BE ANSWERED

- take observance from the field and suggestions from theory to the lab
- introduction of (discontinuous and highly uncertain) tipping points (e.g. THC, collapse of polar ice caps…), and proper introduction of functional form for public bad
- hawk-dove game (evolutionary dynamics)
  - dynamics lead to extinction of doves and population consisting of hawks only (free-riders)
  - translated into why intrinsic motivation declines when subjects play with a lot of free-riders
- idea for the paper is to test effectiveness in realising a critical level of a public good (or analogously preventing a certain level of a public bad) for willing and non-willing subjects in an economic environment
- *research question:*
  - will a separation of agents into willing and non-willing sets make it more likely to achieve a certain threshold of a “public good” under a collective social dilemma setting?

Experimental design I/V

the experiment and its environment

- collective social dilemma with a general framing language played in a group of 12 subjects
- collective social dilemma captures lost investments (MSR = 0) is framed as PG game, the sure outcome that everyone loses everything if threshold not achieved, as well as an inherent coordination problem if many players are involved
- experiment is divided into 3 stages

- <u>1st stage:</u> one shot collective social dilemma (similar to Gächter & Thöni (2005) in approach)
    - decide whether to hold the initial endowment of 4 tokens on the private account or invest into avoidance of losing everything (similar to climate change game (X-bar as global abatement) or labour game in general)

Experimental design II/V

individual’s payoff function after stage 1:

$$P_i(x_i) = \begin{cases} 4 - x_i & if\ \bar{X} \geq 30 \\ 0 & if\ \bar{X} < 30 \end{cases}$$

$$s.t.\ x_i \in \{0, 0.5, ..., 3.5, 4\}, \bar{X} = \sum_{j=1}^{12} x_j,\ \ j \in 1, ..., i, ..., 12$$

- aim of this stage: get information on individuals’ willingness to prevent “public bad”
    - possibility in 1st stage that if at least 3 people coordinate at second highest highest contribution level or above (i.e. 3.5 or 4) then their invested contributions are doubled towards X bar

Experimental design III/V

- <u>2nd & 3rd stage:</u>

10-period collective social dilemma game

  - each individual's initial endowment: *40 tokens*
  - possible contribution level in each period: *0, 0.5, ..., 3.5, 4 tokens*
  - after each period: feedback on the contribution levels from all players in the same group and total accumulated contributions of the group
  - threshold on the level in the group account: *300 tokens*
  - possibility that if at least 3 people coordinate at second highest or highest contribution levels (i.e. 3.5 and 4) then their invested contributions are doubled towards X bar

individual's payoff function after last round in stages 2 & 3:

$$P_i(x_{it}) = \begin{cases} 40 - \sum_{t=1}^{10} x_{it} & if\ \bar{X} \geq 300 \\ 0 & if\ \bar{X} < 300 \end{cases}$$

$$s.t.\ x_{it} \in \{0, 0.5, ..., 3.5, 4\}, \bar{X} = \sum_{t=1}^{10} \sum_{j=1}^{12} x_{jt},\ j \in 1, ..., i, ..., 12$$

Experimental design IV/V

- in one stage: all players of the group play together (BASELINE-treatment)
- in the other stage: players are divided into four new subgroups either randomly (RAND-treatment), or according to their cooperation type from stage 1 (TYPE-treatment), i.e. into one VHIGH-subtreatment (highest quarter of contributors in stage 1), one HIGH-subtreatment (second highest quarter of contributors in stage 1), one LOW-subtreatment (second lowest quarter of contributors in stage 1), and VLOW-subtreatment (lowest quarter of contributors in stage 1)
- in the BASELINE-treatment they see average contribution towards X bar, in the subgroup treatments they see accumulation towards X bar as well as the others' contributions in their subgroup
- in each subgroup (as well as the BASELINE-treatment) there exists the possibility to double contributions if at least three people achieve to contribute 3.5 or 4 (in the same subgroup)
- features coordination and PG characteristic
- ...mixing stages 2 and 3 as some learning effects are expected to occur

EXPERIMENTAL DESIGN V/V

- show-up fee of 10 AUD
- each token is worth 0.5 AUD
- all 3 stages are paid
- subjects will either participate in the RAND-treatment or in the TYPE-treatment
    - within-subject and between-subject design
- comprehension questionnaire before stage 1
- in stage 1 ranking scheme will determine subgroup assignment
    - if same people have same contribution level, dice will determine which of them comes into which subgroup

PREDICTIONS

- Hypothesis 0
  - subjects in the VHIGH-treatment exhibit similar behaviour in the start of the game in stages 2 and 3 as in their elicitation of types in stage 1 (so they are correctly matched)
- Hypothesis 1
  - subjects are more likely to individually contribute more on average and achieve the threshold in the TYPE-treatment than in the BASELINE-treatment
- Hypothesis 2
  - subjects are more likely to individually contribute more on average and achieve the threshold in the TYPE-treatment than in the RAND-treatment (so subgroup assignment matters)
- Hypothesis 3
  - coordination in the VHIGH-subtreatment to double contributions at level 3.5 is more likely to happen than in the other subtreatments
- Hypothesis 4
  - inequality and fairness preferences for subjects in the VHIGH-subtreatment play a minor role

POSSIBLE EXTENSIONS

- use probabilities that zero payoff happens (e.g. Milinski et al. (2008))
- in order to be closer to the case of smaller-sized climate clubs, or findings that stable coalition sizes for cooperation usually involve around n*=3, test performance of 3-person group vs. 6-person group with the same game, but only introducing SMR as well as probabilities associated to the threshold, which would be doubled for 3-person group as threshold would be held constant for both groups and thus to account for group size effects
- drop general framing of PG, use environmental language (similar to Nordhaus (2015), Milinski et al. (2008)) and compare difference effects
- alter 1st stage to elicit true preferences and to match subjects to right groups afterwards, accompany one-shot game with some sort of conditional cooperation test

QUESTIONS & DISCUSSION

- how to elicit true / cooperation preferences in the 1st stage… are they different to specific cooperation preferences (environmental / social framing, general etc.)?
- how to disentangle conditional cooperation and unconditional cooperation (altruistic preferences) in a theoretical model?
- allow communication between periods (better representation of negotiations in reality)?
- how is this linked to tournament / contest games? how is this related to coordination and group-decision making?