We are not alone: The impact of externalities on public good provision

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Public good provision with externalities

Public goods benefit the group of (potential) providers and additionally may benefit outsiders (positive externality)

- ☺ local public good: equatorial countries preserving the rain forest
- ☺ positive externality on world's climate and biodiversity

- ☺ local public good: a metropolitan area subsidizing an opera house
- ☺ positive externality on visitors from further away, who do not pay local taxes

Public good provision with externalities

Public goods benefit the group of (potential) providers and additionally may harm outsiders (negative externality)

- ☺ local public good: constructing a landfill to keep garbage off the streets
- ☹ negative externality on the households in the vicinity (financial and environmental risks)

- ☺ local public good: a country close to the source of an international river building a dam
- ☹ negative externality on countries at the estuary of the river

Public good provision with externalities

Research questions

- How does the existence of external effects affect public good provision?
- In which way do social norms interact with externalities in public good provision?

Approach

- Laboratory experiment comparing public good provision in three treatments:
  - positive externality
  - negative externality
  - no externality (control)
- Voting on non-binding recommended contributions

Related literature

- Numerous public good experiments have been conducted
  - some in a social context, like group competition (e.g. Bornstein 2003)
  - but (n)one with externalities on inactive others (Humphrey and Renner 2010).

- Externalities affecting inactive others in different contexts:
  - ultimatum game with a “dummy” player (Güth & van Damme 1998)
  - bribery game (Abbink 2005)
  - lottery choice task (Bolton & Ockenfels 2010)
  - organizational structure and communication (Ellman & Pezanis-Christou 2010)

The public goods game with externalities

- 4 actors play a linear public goods game
  - each actor is endowed with 20
  - each actor may contribute 0, 10, or 20 to a public good; the remainder from 20 is kept for the actor's private account
  - actor's payoff = 20 – actor's contribution + 0.4·G

    (with G = sum of the contributions of all 4 actors)

- 3 bystanders are affected by the public good
  - each bystander is endowed with 20
  - bystanders cannot contribute to the public good, but …
  - … the public good creates an externality on bystanders:
    - positive externality treatment: bystanders' payoff = 20 + 0.2·G
    - negative externality treatment: bystanders' payoff = 20 – 0.2·G
    - no externality (control): bystanders' payoff = 20

Predictions and Implementation

The public goods game with externalities is a social dilemma

- individual payoff maximization as well as inequity aversion (Fehr & Schmidt 1999) → free-riding on the contributions to the public good
- full contributions to the public good → social optimum
- no treatment differences

Experimental implementation

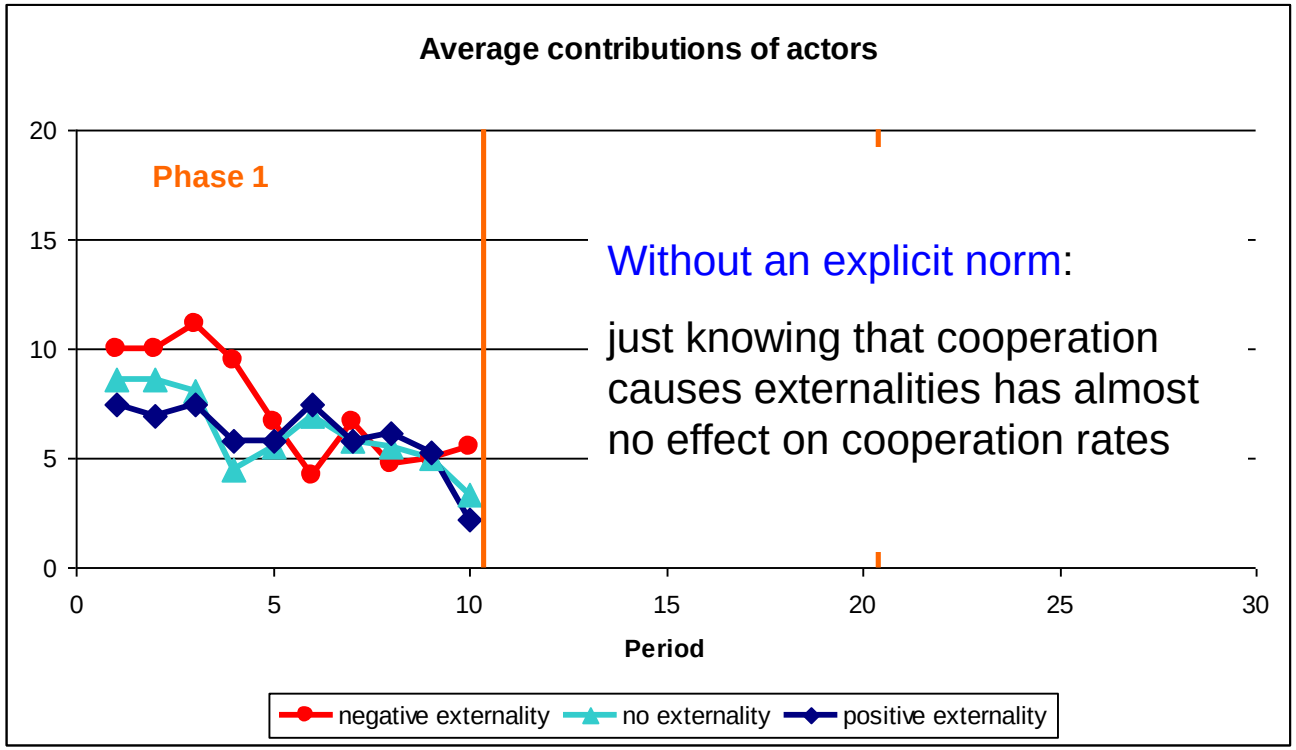
- computerized laboratory experiment, *elab* (University of Erfurt)
- recruiting via ORSEE; programming in z-Tree
- subjects were paid according to earnings

- 9 independent observations in both treatments and in the control
- 7 subjects in each session (i.e. 189 subjects in total)

- 3 phases with 10 rounds each

Phase 1

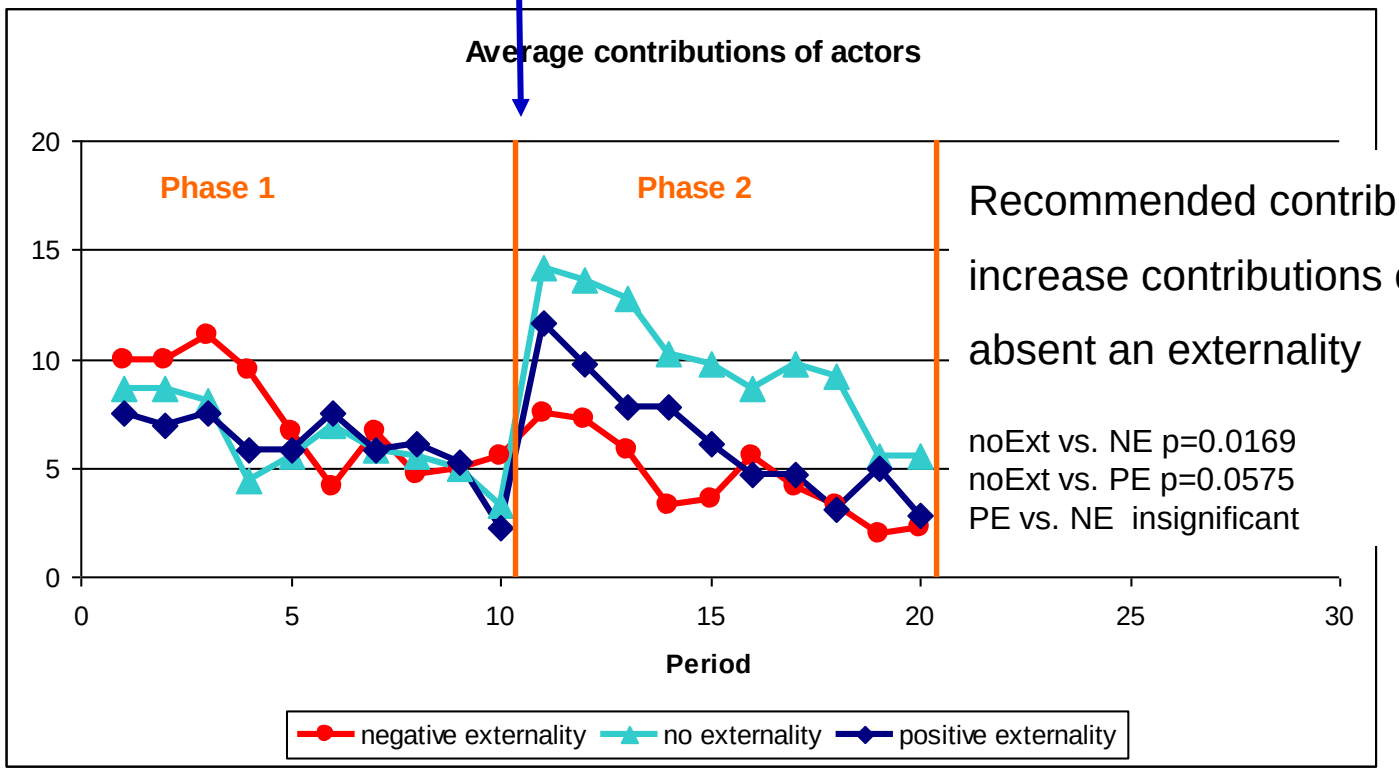
- allocation of the 7 players to 4 active und 3 passive before round 1
- fixed roles
- game repeated for 10 rounds



Phase 2

- re-shuffling in active and passive players before round 1 of phase 2
- vote for a “recommended contribution” to the active before role allocation

recommended contribution non-binding; 10 rounds with fixed roles



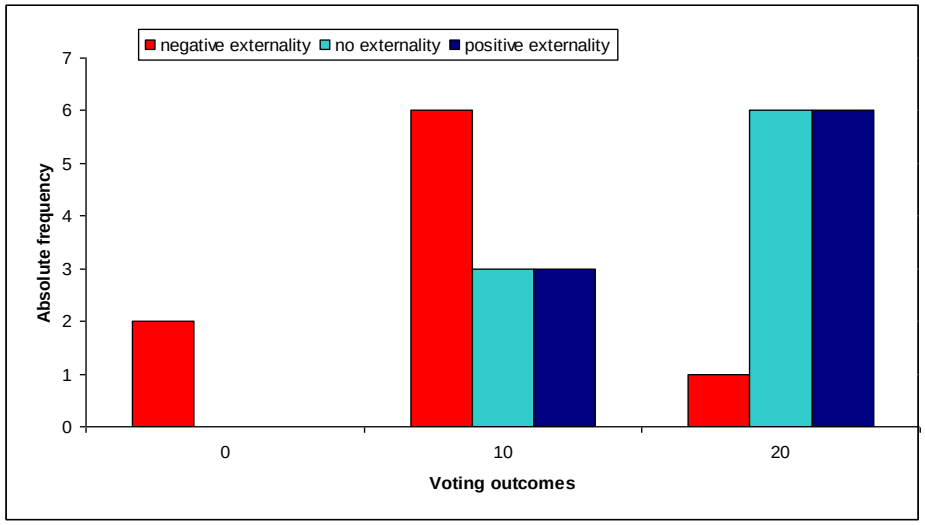
Recommended contributions increase contributions only absent an externality

noExt vs. NE p=0.0169
noExt vs. PE p=0.0575
PE vs. NE insignificant

The phenomenon of low contributions in PE

- Reasons on the macro (aggregated) level
  - recommended contributions
  - norm compliance
- Reasons on the micro (individual) level
  - contribution dynamics

Recommended contributions and compliance

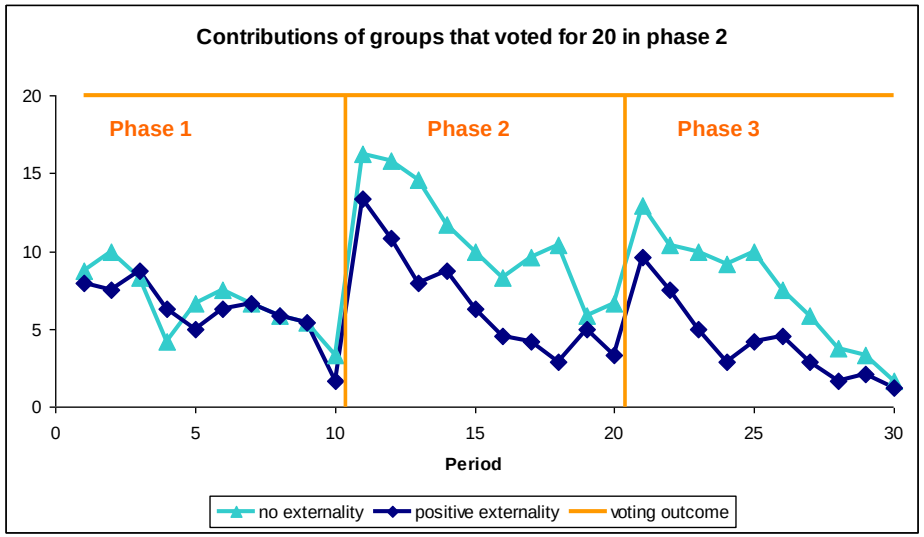


Recommended contributions are …

… lowest for negative externalities

… not higher for positive externalities than without an effect on outsiders

(NE vs. noExt p=0.0128; NE vs. PE p=0.0128)



Positive effects on outsiders lead to lower compliance to the recommended contribution than without an effect on outsiders

Contribution dynamics

- Active players are conditionally cooperative …
  - the higher the active‘s last round payoff, as compared to the other active players, the more an active increases her contribution

- … but they do not want to fall back behind the passive players
  - in PE: The difference between the payoffs of an active and a passive player is typically negative
  - the greater this difference is, the greater is the contribution reduction of the active players

  →this effect is so strong that it dominates conditional cooperation

  - In NE and the control: The difference between the payoffs of an active and a passive player is typically positive

  →conditional cooperation remains the dominating force

The risk of being the sucker…

… is highest with positive externality!

- Cooperative players not only risk to fall behind the free-riders within their group, but also behind the outsiders.
  - → this leads to lower provision levels than in the no externality case
  - → creates the greatest welfare loss

in PE cooperators have the lowest payoff compared to bystanders and deviators

Example: 3 actors contribute 20 ("cooperators", "suckers") and one actor contributes 0 ("deviator")

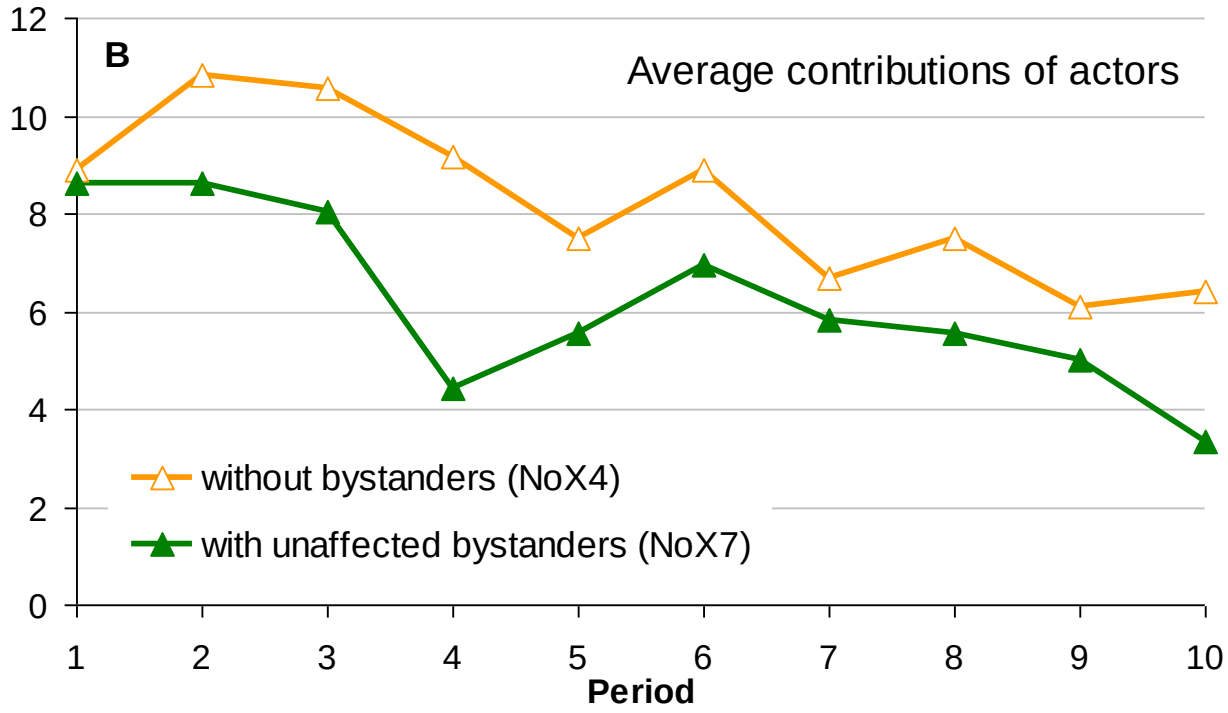
treatment	cooperators' payoff	deviator's payoff	bystanders' payoff
positive externality	24	44	32
no externality	24	44	20
negative externality	24	44	8

Extending the parameter space

- 4 active players and no bystanders (*Nox4*)
- 4 active players and 3 unaffected bystanders with endowment 20 (*Nox7*)
- varying the endowments of the affected bystanders
  - positive externality on
    - poor bystanders (endowment of 0; *PE0*)
    - equally endowed bystanders (endowment 20; *PE20*)
    - rich bystanders (endowment of 40; *PE40*)
  - negative externalities on
    - equally endowed bystanders (endowment 20; *NE20*)
    - rich bystanders (endowment of 60; *NE60*)

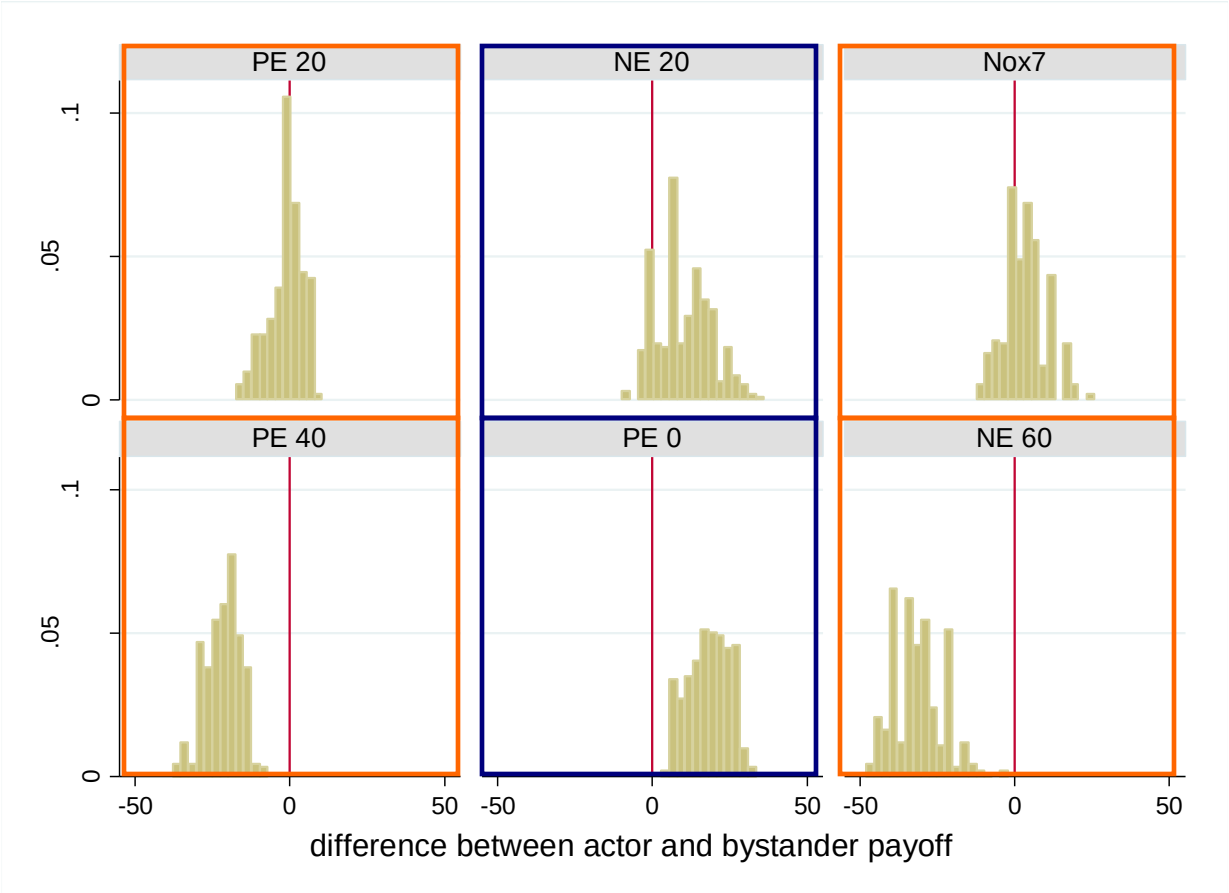
9 independent observations in each parameter constellation

Contributions without an externality



Contributions absent any bystanders are (weakly) significantly higher than when unaffected bystanders are present (p = .0631)

Contributions with an externality



Compared to the baseline *Nox4*, contributions are

- significantly lower, whenever actors risk falling behind bystanders
- not significantly different, whenever actors are ahead of bystanders

Contribution Dynamics

- Actors are conditional cooperators, but externalities on bystanders reduce contributions whenever actors risk to fall behind bystanders.

- The nature of the externality is immaterial for the contribution behavior, but payoff comparisons are not:
  - → The presence of bystanders does not reduce actors' contributions if bystanders (almost) always receive a lower payoff than actors.
  - → When bystanders outperform actors, their presence reduces contributions, no matter whether actors' contributions actually affect bystanders or not.

- Alternative explanations
  - → *Guilt aversion* would not lead to different results in *Nox4* and *Nox7*
  - → *Desert* may explain high contributions in *PE0*, but not in *NE20*.

Outlook

- More elaborate institutions seem necessary to “protect” conditional cooperators, especially when providers risk to fall behind outsiders
  - → compensation of providers
  - → enlargement of the group of potential providers

Thank you for
your attention!