Master Thesis

Providing Environmental Public Goods: Increasing Cooperation Incentives

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Executive Summary

David Hofmann

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University of Zurich[UZH]

Motivation & Methodology

Already in the 18th century scholars realized that individual behavior can be detrimental to society's long-term interests. Hans Carl von Carlowitz (1713), for instance, observed that the rate of deforestation at the time exceeded the rate of regeneration, which is why he hypothesized that future generations would eventually suffer from a shortage in wood-supply. While Carlowitz was concerned about the undamped deforestation of valuable wood at the time, we face comparable issues today. As we continue to burn fossil fuels and release greenhouse gases into the atmosphere, we increase the probability of dangerous climate change and jeopardize future generations' possibility to profit from a healthy environment. Similarly, the ongoing destruction and fragmentation of animal habitats raise the number of endangered species, although their presence is crucial for the provision of important ecosystem services. One can easily think of many more examples where individual short-term benefits are made to the detriment of global society and future generations.

Several negative consequences of human behavior on planet Earth were already revealed in the seventies, when the Club of Rome released its seminal work *The Limits to Growth* (Meadows et al. (1972)). Nevertheless, suitable solutions are still scarce and rarely implemented. According to current evaluations of the *Planetary Boundaries*, we have already left the safe-operating space for numerous earth system processes, such as for biodiversity loss and climate change. Humanity therefore faces a high probability of crossing dangerous tipping points in these systems. Beyond these tipping points, consequences are difficult to predict and damages potentially irreversible. Because of the already undeniable impacts of human activities on planet Earth, the Nobel Prize winner Paul J. Crutzen has even proposed the beginning of a new geological epoch: the *Anthropocene* (Crutzen and Stoermer (2000)).

Many of the earth systems in danger, including biodiversity and climate change, have one thing in common; they are public goods. In addition, they are *global* and *environmental* public goods, such that their provision can only be ensured through international cooperation. However, relevant actors, such as individuals, companies and countries, often hesitate to contribute to the efforts of protecting the climate and preserving biodiversity. Provided that actors are aware that a failure of cooperation leads to irreversible consequences, why are they so reluctant to cooperate and how can cooperation incentives be increased? Is it feasible to achieve full, or at least almost full cooperation?

When trying to find explanations and solutions to the observed issues, scientists and policymakers typically base their reasoning on the assumption of rational actors. Rational actors are solely driven by materialistic incentives and they are predicted to behave ruthlessly towards others. Unless pro-social behavior benefits them in some or another way, they are unwilling to behave pro-socially. The notion of this "homo economicus" is often supported by theorists who argue that market powers eliminate irrational behavior anyway (Gsottbauer and van den Bergh (2011) and McFadden et al. (1999)). But already Adam Smith realized that human behavior is not entirely determined by monetary payoffs (Smith (1759)). In fact, many experiments prove the opposite and show that humans behave more pro-socially than predicted by the rational actor model. For instance, individuals cooperate in PGGs (Ledyard (1995)) and reject unfair offers in ultimatum games (Güth et al. (1982), Thaler (1988) and Camerer (2003)). Under certain circumstances, the rational-actor model therefore performs poorly as a predictor for true human behavior. In order to construct a more realistic and reliable model of human behavior, behavioral economics aims to integrate important findings from psychology into economics. It makes the following general observations about human behavior (Shogren and Taylor (2008) and Carlsson and Johansson-Stenman (2012)):

- Bounded self-interest: individuals are not solely driven by materialistic incentives. They are influenced by fairness considerations and social norms.
- Social approval: humans make decisions in a social context in which social approval and status influence individual decisions.
- Bounded rationality: humans regularly violate rationality assumptions due to their inability to process unlimited amounts of information.

Surprisingly, such findings did not yet find their way into environmental policymaking. Nevertheless, their integration would certainly improve the impact of relevant policies. The aim of this thesis is to tighten this gap. It is therefore acknowledged that humans do not always behave as predicted by the rational actor model. With the main focus on climate change, it is argued that many incentive issues can be compared to those that are analyzed in laboratory social dilemmas, especially in PGGs. In these games, individual incentives are at odds with social optimality and a socially suboptimal outcome is predicted. Scientists have conducted an overwhelming amount of experiments which disprove the prediction of completely egoistic behavior. In contrast to game theoretic predictions, almost full cooperation can be achieved under appropriate conditions. In this thesis, the key-drivers of cooperation are identified and used to derive policy clues, which then help to increase cooperation-incentives to provide environmental public goods. This target is accomplished via consolidating results from behavioral, experimental and environmental economics and by applying them to the real world issue of climate change. The core of climate change is a typical PG provision problem. Because emissions disperse quickly across borders, efforts to reduce greenhouse gases create benefits which spill over to other countries. Thus, a country that invests in the reduction of greenhouse gases cannot prevent others' from benefitting as well. This incentive structure provides room to free-ride on others' mitigation efforts. Each country could wait and hope that other countries engage in costly mitigation actions to offset climate change. But then, if all actors pursue their personal interests, the outcome will be globally suboptimal, since global warming is not prevented. A solution to this dilemma could be a binding international climate agreement. If enough parties agree to restrict their emissions, a better outcome could be achieved. But again, such an agreement constitutes a PG. Countries come together and negotiate in several sessions on possible solutions to provide an environmental PG. While all countries would be better off if an agreement is reached, all have an incentive to free-ride. In its fifth assessment report the IPCC perfectly summarizes the problematic of climate change:

> *"Climate change has the characteristics of a collective action problem at the global scale, because most greenhouse gases accumulate over time and mix globally, and emissions by any agent (e.g., individual, community, company, country) affect other agents. Effective mitigation will not be achieved if individual agents advance their own interests independently. Cooperative responses, including international cooperation, are therefore required to effectively mitigate greenhouse gas emissions and address other climate change issues."* (IPCC (2014, p.17))

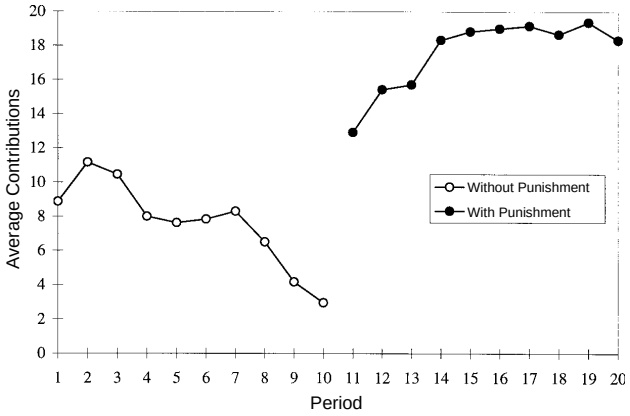
The quotation neatly illustrates that climate change and laboratory PGGs are quite similar in their incentive structures.

Results

A review of the literature from behavioral, experimental and environmental economics reveals that several factors strongly influence actors' willingness to cooperate. Most importantly, it is found that a substantial amount of actors has altruistic traits and is intrinsically willing to cooperate. However, parties typically behave conditionally cooperative and curb their cooperative efforts once they observe defective behavior of others. Nevertheless, cooperation can be increased significantly under appropriate conditions. A quite unexpected promoter of cooperation is the marginal per capita return, for which a higher value correlates with higher cooperation rates. Raising the perceived marginal per capita return of mitigation actions should therefore facilitate their implementation. Another cooperation increase is achieved through positive frames. Rather than harping on the negative consequences of global warming, policymakers should highlight the potential benefits of a healthy climate. Other factors, such as various types of heterogeneity, discourage contributions to public goods. The negative consequences of heterogeneity can be circumvented through individualized mitigation targets that account for heterogeneity and through cooperative attempts that only involve parties which can be considered as homogeneous. Another negative impact is accredited to uncertainty. Especially uncertainty regarding environmental thresholds has a negative impact on cooperation. For this reason, scientists need to determine dangerous tipping points as precisely as possible. Furthermore it is shown that an effective climate agreement should involve the possibility to sanction non-compliant actors. Sanctions strongly reduce the incidence of free-riding and allow to achieve almost full cooperation (see Figure 1). Although rewards offer a less destructive alternative, their power is rather limited in comparison to the power of punishment. Further advancements in cooperation can be stimulated if relevant parties frequently engage in meetings and climate talks. Such discussions allow to coordinate actions and to make pledges to which parties usually adhere. Additionally, positive effects can be achieved if pro-social norms are established and enforced. Norms typically govern pro-social behavior even in cases where no supra-national authority is present. Moreover, it is found that the imposition of mitigation burden has to be fair and should equalize payoffs across actors. Only if the distributional outcome can be considered as fair, the respective parties are willing to participate in international efforts to reduce greenhouse gas emissions. This implies an increased burden for developed countries. Reputational effects are important as well, such that reducing anonymity promotes pro-social behavior. Finally, an important role is accredited to first-movers, as their behavior considerably influences followers' actions. Overall, laboratory PGGs suggest that numerous factors strongly influence cooperation and that a proper balance of these factors allows to achieve very high levels of cooperation. These factors are consolidated again in a number of policy clues which can be found on page 5.

Above all, it is not yet clear whether relevant parties will manage to provide an intact environment, as well as other essential public goods, to future generations. Nevertheless, this thesis shows that it is feasible to achieve effective cooperation even in social dilemmas such as in climate change. In any case, only through effective cooperation humanity can achieve what individual efforts cannot provide. Failing to cooperate clearly constitutes the worst of all possible outcomes.

Figure 1: Effects of Punishment in the Partner-Treatment



The punishment opportunity is introduced in period 11, in which cooperation shoots up immediately. The graph also shows that the deteriorating cooperation-pattern can be reversed through the introduction of a punishment possibility. Source: Fehr and Gächter (2000).

Evaluation & Outlook for Future Research

This thesis is most closely related to the works of Brekke and Johansson-Stenman (2008), Gowdy (2008), Shogren and Taylor (2008), Gsottbauer and van den Bergh (2011) and Carlsson and Johansson-Stenman (2012), who examine the implications of behavioral economics for climate change policy. However, their work is less focused on the findings from PGGs, which is the main approach of this thesis. By giving an overview of factors that determine cooperation in social dilemmas, this work also adds to the growing literature of PGGs. The consolidation of the extensive amount of research on social dilemmas allows to reveal a number of important determinants of cooperation in situations where individual incentives opposes social desires. Although many different studies are considered, it is impossible to give an exhaustive and conclusive review. The literature in this area is still growing exponentially, which makes it impossible to keep track of all insights that are being generated. Nonetheless, some questions remain unanswered. For instance, it is not clear how productivity-uncertainty influences cooperation. While subjects typically know the impact of their contributions in PGGs, this is not necessarily true in reality. The consequences of climate action are quite fuzzy and difficult to predict. Introducing stochastic productivity in a PGG would therefore offer interesting insights that are certainly important for reality. Moreover, no study has yet investigated the effects of delayed payoffs in PGGs. Yet, in many real world PGGs the benefits of contributions do not accrue immediately. The benefits of climate action, for instance, will only accumulate over many years. Thus, those who contribute to the protection of the climate are probably not even able to reap the resulting benefits. In an adjusted PGG one could replicate such a delay-effect or even introduce two groups where one group (representing the current generation) has to cooperate in order to produce a PG for a second group (representing the future generation). Since countries currently self-report their greenhouse gas emissions, another experiment could examine how self-reporting of contributions in a PGG influences subjects' behavior. Especially when punishment is possible, it is likely that overreporting, i.e. underreporting of greenhouse gas emissions, occurs frequently. A last worry concerns the external validity of PGGs. Unfortunately, many researchers still rely on subject pools that only contain students from western, industrialized countries. This is too much of a generalization, particularly because those studies that expand their subject pool often find significant behavioral discrepancies. Future research should strive to include a wider variety of subjects and verify that the results hold true in other cultures as well.

Appendix A: Summary of Policy Clues

Policy Clue 1 *It can be expected that the majority of actors is initially willing to engage in cooperative efforts. Yet, such cooperators are likely curb pro-social behavior whenever they feel that others exploit their benevolence.*

Policy Clue 2 *The incentives to invest in mitigation actions can be boosted if the perceived marginal per capita return of such actions is increased.*

Policy Clue 3 *Subtle changes in representation can significantly alter cooperation incentives. Especially pro-social frames induce cooperative behavior.*

Policy Clue 4 *Heterogeneity among actors impedes cooperation and lowers the provision of environmental public goods.*

Policy Clue 5 *In environments that involve uncertainties, actors find it difficult to cooperate.*

Policy Clue 6 *Altruistic punishment is an effective tool to patronize cooperation and to reverse its downward trend. In the long run, it deters free-riders and increases net-benefits.*

Policy Clue 7 *Despite initial aversion against sanctions, subjects eventually learn about their usefulness and become willing to vote in favor of a punishment institution.*

Policy Clue 8 *The use of sanctions in case of imprecise information can be dangerous, mainly because wrongly punished actors retaliate and engage in antisocial punishment.*

Policy Clue 9 *A combination of punishment and rewards allows to achieve high cooperation rates.*

Policy Clue 10 *Disadvantaged parties will not step in if more capable parties fail to tackle current issues.*

Policy Clue 11 *Communication allows to coordinate behavior and to convey intentions. This in turn increases cooperation substantially.*

Policy Clue 12 *A combination of rich communication and punishment leads to almost full cooperation.*

Policy Clue 13 *Norms are important determinants of behavior and act as default guidelines. Depending on the context of the situation, different norms can be activated. Once a norm is activated, it effectively governs cooperative behavior in the absence of binding agreements.*

Policy Clue 14 *Because parties are likely to reject any agreement that they perceive as unfair, fairness is absolutely necessary to achieve cooperation. However, subjects' fairness-perceptions are often influenced by a self-serving bias, which makes it more difficult to objectively assess the fairness of an outcome.*

Policy Clue 15 *Actors care about their reputation. Reducing anonymity is therefore expected to result in an increase of pro-social behavior in social dilemmas.*

Policy Clue 16 *First-movers strongly influence their group-members' willingness to cooperate. Leading by example successfully enhances cooperation.*