

May 2019

Description of research project:
From Kyoto to Paris - Effectiveness of Alternative Climate Change Agreements

Thomas Markussen, Alexander Sebald and Hans Jørgen Whitta-Jacobsen
Department of Economics, University of Copenhagen

The purpose of this project is to provide insights into the relative effectiveness of two alternative types of international agreements aimed at alleviating the problem of climate change. More precisely, the research project will analyze, theoretically as well as experimentally, the relative effectiveness of a Kyoto-type and a Paris-type of climate agreement.

The Paris Agreement on climate change (finalized in December 2015) involves a radical change of strategy compared to the Kyoto Agreement (adopted in December 1997, entering into force in February 2005, and amended by the Doha Amendment to the Kyoto Protocol of December 2012). The change implied the movement from QUELRO (quantified emission limitation and reduction objectives) under the Kyoto to NDC (nationally determined contributions) under the Paris agreement. The Kyoto Protocol defined specific reductions of emissions of greenhouse gasses over a specified period (QUELRO) for each participating (Annex I) nation. On the other hand, the Paris agreement only obliges each participating nation (or group of nations) to report self-elected reductions (NDC) which are made public and can only be increased in regular intervals.

During several United Nations Climate Change Conferences, the so-called COP conferences held each year in December, the nations of the world had attempted at arriving at a renewal and strengthening of the Kyoto agreement (originally in effect from 2005 to 2013, and extended to 2020 by the Doha Amendment). They did not succeed, most probably because the involved nations were not willing to formally commit to specific (and increased) contributions of the QUELRO type. In an effort to break the deadlock and incentivise all nations to participate, the Paris Agreement made a shift to contributions of the NDC type.

On the face of it, an agreement of the Kyoto-type seems much stronger than one of the Paris-type, but more difficult to arrive at, exactly because the first but not the latter involves “binding” contributions. Seemingly, there is a trade-off between the strength of the agreement and the degree to which nations are willing to participate in it.

This project is concerned with this tension and asks the research questions: Is it true that a Kyoto-type of agreement must be expected to give better results (larger emission reductions) than a Paris-type of agreement given that the agreement is “on the table”, so to say, and involves the same aspirations? Is it true that an agreement of the Paris-type is more easy to arrive at than one of the Kyoto-type, but if arrived at gives poorer results?

To answer these research questions we first develop a theoretical framework that mimics essential details of the world climate change problem. This theoretical framework serves as a basis for the main part of the project: an experimental investigation of the relative effectiveness of the two climate agreements.

An important fact in relation to agreements to combat climate change is that, in a formal sense, commitment is not possible: there is no court to take a nation to if it does not deliver the reductions it agreed upon in a Kyoto-type of agreement or promised by itself in a Paris type of agreement. A standard theoretical analysis therefore predicts that all nations free ride and, at the end of the day, deliver zero contributions (i.e., the reductions they would have arrived at without any agreement). For an agreement to have any bite there must be some individual cost to a nation of not doing as agreed upon (in the Kyoto case) or of promising a too low contribution or not living up to what was promised (in the Paris case). Such a cost could arise from a loss of international reputation, which could lead to poorer results of the nation in other international settings, e.g., trade agreements, or from self-image concerns.

Interestingly the existence and impact of such reputational costs and image concerns have been widely studied in the literature on social dilemmas (e.g. Ostrom, Walker and Gardner 1992, Wilson and Sell 1997, Fehr and Gächter 2000, Masclet et al. 2003). Their implications for the effectiveness of international climate agreements have been widely ignored so far however. It is a natural idea that if there are such image costs they will in the Kyoto case be associated with delivering less than written in the agreement and in the Paris case be associated with promising a lower contribution than other comparable nations (or not living up to one's promise to the same degree as other nations). Accepting this idea, the (game) theoretical part of the project asks whether one or the other type of agreement can be expected to yield the best results (the contributions closest to the social optimum of the underlying public goods game).

The experimental part of the research project uses the setup developed in the theoretical analysis. Specifically it implements a public goods game in the lab that mimics aspects of the real world climate game. Important elements of the design will be:

- The total contribution of a participant is not decided once and for all, but built up over many rounds. After each round, each participant obtains knowledge of how much the other participants have contributed so far.
- Alternative agreements are implemented in different treatments: a Kyoto-type by stipulating an “agreed upon” contribution for each participant and a Paris-type by stating a certain total contribution for the entire group (corresponding to the 1½-2 degree target) and asking each participant to announce repeatedly after a number of rounds a revised total intended contribution.

In total three series of experiments, each involving around 250 participants, are planned (one pilot experiment has already been conducted) to answer the aforementioned research questions:

1. *Agreement on the table: Kyoto versus Paris versus no agreement.* Here a specific type of agreement or no agreement is forced upon the subjects. We study which type of agreement gives the most optimal results. The pilot experiment only confronted Kyoto vs. Paris and thus provided evidence on their relative performances, but not on the performances of the agreements relative to no agreement. It also had relatively few subjects. The plan is to perform an experiment in much larger scale comparing all three possibilities. This will probably be done in the Fall of 2019 partly as student experiments that should be done under all circumstances in connection with the course Economic Principles A at the Department of Economics, University of Copenhagen. Although the pilot experiment involved relatively few subjects and is thus not very conclusive, it suggested interesting results: if anything the

Paris-type of agreement seems to perform better than a Kyoto-type given that the agreements are on the table and have the same aspirations.

2. *Endogenous punishments*. As mentioned the agreements of the real world probably, if they work, to a large extent work through implicit reputational costs. This line of experiments will add a successive punishment phase (where participants are able to reduce the earnings of other participants at a cost) to the games described in point 1 and investigate how this influences the relative performance of the two types of agreement.
3. *Endogenous agreement*. As also mentioned the motivation behind the shift from the Kyoto- to the Paris-type of agreement probably was to enhance participation. This line of experiments will add to the underlying public goods game a preceding negotiation phase, where participants attempt to arrive at either a Kyoto or a Paris-type of agreement within a certain time limit. “No agreement” is the default outcome in case of a failure to agree. It is investigated which type of outcome (and agreement) most often occurs and how the performance in the succeeding public goods game depends on which type of agreement was endogenously decided on.

We may add an experiment involving both pre-negotiation and post-punishment (i.e., an experiment that combines points 2 and 3).

Further about the research proposal:

Policy relevance: The project provides insight into one of the most important policy issues in the world, if not the single most important one: *how to obtain the most effective international agreement on reducing greenhouse gas emissions involving the widest possible participation of nations*.

Project period: August 2019 to August 2022.

Publication plans: The project aims at publishing 1-2 articles in the best international journals that publish research related to the economic and policy aspects of climate change, e.g., PNAS, AER, AEJ:EP, Management Science, JPubE, Journal of the Association of Environmental and Resource Economists, Journal of Environmental Economics and Management, American Journal of Environmental and Resource Economics etc.

Related literature:

The single most closely related paper is:

Tavoni, Dannenberg, Kallis and Löschel: “Inequality, Communication, and the Avoidance of Disastrous Climate Change in a Public Goods Game”, *PNAS*, 2011.

However, this paper constructs the underlying public goods game such that the state where every participant (country) contributes what is required to save the planet is a Nash equilibrium, that is, an equilibrium in individual contributions of the non-cooperative game. We think this misses the point of the real world climate game. Furthermore, the paper does not compare alternative types of agreements, but only studies the working of a Paris-type of agreement. Other related contributions:

Milinski et. al.: “Stabilizing the Earth's Climate is not a Losing Game: Supporting Evidence from Public Goods Experiments”, *PNAS*, 2006.

Kosfeld et. al.: "Institution Formation in Public Goods Games", *AER*, 2009.

Barrett: "Climate Treaties and Approaching Catastrophes", *Journal of Environmental Economics and Management*, 2013.

Hasson et. al.: "Climate Change in a Public Goods Game: Investment Decision in Mitigation versus Adaption", *Ecological Economics*, 2010.

Bochet et. al.: "Communication and Punishment in Voluntary Contribution Experiments", *JEBO*, 2006.

Ostrom et al.: "Covenants With and Without a Sword: Self-Governance Is Possible", *American Political Science Review*, 1992.

Fehr and Gächter: "Cooperation and Punishment in Public Goods Experiments", *AER*, 2000

Maclet et al.: "Monetary and Nonmonetary Punishment in the Voluntary Contribution Mechanism", *AER*, 2003.

Wilson and Sell: "Liar, Liar ... Cheap Talk and Reputation in Repeated Public Goods Settings", *Journal of Conflict Resolution*, 1997.