Climate Contracts: A Theory of Emissions, Investments, and Negotiations

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By Bård Harstad

1. **Introduction**
   Existing environmental policies and treaties share several features that we ought to take into account in a formal analysis. This chapter motivates the assumptions to be used in the analysis.

2. **A model of emissions and technology**
   A tractable non-cooperative stochastic game is presented where several countries are both emitting and investing in technologies over time. The game allows for uncertainty and contracts.

3. **Business as usual**
   Dynamic games have multiple equilibria. This chapter discusses likely non-cooperative outcomes of the game, and shows why the dynamic common-pool problem is worse than the static version.

4. **Self-enforcing agreements and technology**
   Without a world government, cooperation must be motivated by mutual long-run relationships. When cooperation is difficult to sustain, technological investments must restore credibility.

5. **Legally binding agreements**
   In reality, countries may partially be able to commit to certain variables, but not to others. If so, how should f.ex. emission quotas be set, when they will also influence technology investments?

6. **Short-term vs. long-term agreements**
   Short-term agreements may lead to hold-up problems that discourage investments, and they can be worse than no agreement. But it is also difficult to specify the right quotas for the far future.

7. **Renegotiation and updating**
   With new information, old promises should and will be reviewed. Renegotiations can ruin the benefit of commitments or lead to the first-best outcome, depending on how they are designed.

8. **Trade agreements and intellectual property rights**
   Technological spillovers mean that others benefit if one invests. If the spillover is large and important (i.e., IPRs are weak), the treaty should be more ambitious and long-lasting, it is shown.

9. **Participation and coalition size**
   With free riders, the remaining coalition prefers short-term commitments, as it hopes for a larger coalition later. Since this leads to falls in investments (cf. chapter 6), free riding is costly. Thus, the coalition size may be larger if the treaty specifies only emissions and not investments!

10. **Conclusions and the path ahead**
    The framework developed in this book is tractable and it can and should be used to analyze a number of remaining issues. This chapter sets the stage for a research agenda that is both important and promising.

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Real-world climate and environmental agreements have a number of characteristics. In particular, a treaty may specify emission caps, but typically only for a number of (5-10) years. Also, treaties seldom pin down investment levels in new "green" technology, even though technology is often praised as being part of the solution. Motivated by these facts, this manuscript describes and analyzes the interaction between different countries as a dynamic game. Games with multiple stocks (such as pollution stocks and technology stocks) are often very complicated to analyze, but the framework here draws on innovative simplifying assumptions. The framework is used to shed light on a number of relevant questions, such as how treaties should be structured and revised over time. The analysis shows, for example, that short-term agreements may discourage countries from investing in technology, and may be worse than no agreement at all. Further, the optimal duration is analyses and shown to depend on existing trade policies and agreement. The optimal duration will also depend on the number of participating countries, since a smaller coalition will prefer a short-term agreement when it hopes for a larger coalition in the future. Since short-term agreements discourage investments, it is very costly for everyone that the coalition ends up being small. This effect reduces the incentive to free-ride, and the coalition size can therefore be much larger when the coalition can negotiate emissions but not as well investments in new technology. In this way, the often-mentioned flaw of the UN approach (i.e., the fact that it only focuses on emission and not on investments) can be turned into an asset.

While the theoretical framework has important applications for climate agreements and environmental policies, the tractability of the game implies that it also contributes to economic theory, game theory, and contract theory.