

ECON9912C: Dynamic Games in Environmental Economics

Who:	Bård Harstad (bardh@uio.no)
What:	Minicourse (14h/3ECTS credits, PhD level), 2021.
When:	May 26: 14:00-16:00 + 17:00-19:00. May 27: 14:00-16:00 + 17:00-19:00. May 28: 13:00-16:00.
Where:	Zoom (invitation link will be shared by email).
How:	Choose between: 2h take-home exam or 7-12 paged term paper.
Sign up:	https://www.uio.no/studier/emner/sv/oekonomi/ECON9912C/v21
Syllabus date:	May 24, 2021.

This PhD minicourse draws on microeconomic tools, such as dynamic game theory, and offers a coherent framework that can be used to analyze environmental problems as well as solutions. We will model countries' strategic choices of emissions over time, their investments in technology, alternative designs of agreements, free riding, coalition formation, and compliance. Because the problem is dynamic, it is important to think carefully about discounting and time inconsistency. We will end by discussing the political economics of environmental regulation and, if time permits, supply-side regulation.

The material will draw on a large literature (see next page) but [Lecture Note 1](#), [Lecture Note 2](#), [Lecture Note 3](#), and [Lecture Note 4](#) (all are updated May 24 2021) summarize the lectures.

1. Dynamic Games:	Fossil Fuel Emission vs. Investments in Technology
2. Business as Usual:	The Non-cooperative Markov-perfect Equilibrium
3. Incomplete Contracts:	The Best Legally Binding Agreements
4. Coalitions:	Free Riding vs. Participation
5. Compliance:	Self-enforcing Agreements
6. The Future:	Discounting, Political Economics, and Time Inconsistency
If time permits:	Supply-Side Regulation

Required Background:

Mas-Colell, Whinston, and Green (1995): *Microeconomic Theory* (Ch. 7-11), Fudenberg and Tirole (1996): *Game Theory* (Ch. 3-5 and 13), or something similar.

Reading List:

Most of the required reading will be based on lecture notes, such as [Lecture Note 1](#), [Lecture Note 2](#), [Lecture Note 3](#), and [Lecture Note 4](#). These will be substantially updated before class. In addition, we will draw on a number of articles that can also serve as a reference list.

1-2. Dynamic Games: Fossil Fuel Emission vs. Investments in Technology**[Lecture Note 1](#)** (Sections 1-3)

Acemoglu, D., P. Aghion, L. Bursztyn, and D. Hemous (2012): "The Environment and Directed Technical Change," *American Economic Review* 102(1): 131-66

Golombek, R., and M. Hoel (2005): "Climate Policy under Technology Spillovers," *Environmental and Resource Economics* 31(2): 201-27.

Harstad, B. (2012): "Climate Contracts: A Game of Emissions, Investments, Negotiations, and Renegotiations," *Review of Economic Studies* 79(4): 1527-57.

Jaffe, A.B., R.G. Newell and R.N. Stavins (2003): "Technological Change and the Environment," in Mäler, K.-G. and Vincent, J.R., *Handbook of Environmental Economics* 1: 461-516.

Kolstad, C. D., and M. Toman (2005): "The Economics of Climate Policy," *Handbook of Environmental Economics* 3: 1562-93.

Levhari, D. and L. J. Mirman (1980): "The Great Fish War: An Example Using Nash-Cournot Solution," *Bell Journal of Economics* 11: 322--334.

Newell, R.G., A.B. Jaffe and R.N. Stavins (2006): "The Effects of Economic and Policy Incentives on Carbon Mitigation Technologies," *Energy Economics* 28: 563-78.

Ploeg, F.V.D., and A. de Zeeuw (1992): "International aspects of pollution control," *Environmental and Resource Economics* 2(2): 117-39.

2-3. Incomplete Contracts and Agreements**[Lecture Note 1](#)** (Continues: Sections 4-7)

Barrett, S. (1994): "Self-enforcing international environmental agreements," *Oxford Economic Papers* 46: 878-94.

Barrett, S. (2002): "Consensus Treaties," *Journal of Institutional and Theoretical Politics* 158: 519--41.

- Barrett, S. (2005): "The Theory of International Environmental Agreements," Ch. 28 in Mäler, K.-G. and Vincent, J.R., *Handbook of Environmental Economics* 3: 1457-1516.
- Beccherle, J., and J. Tirole (2011): "Regional Initiatives and the Cost of Delaying Binding Climate Change Agreements," *Journal of Public Economics* 95(10-11): 1339-48.
- Buchholz, W., and K. Konrad (1994): "Global Environmental Problems and the Strategic Choice of Technology," *Journal of Economics* 60(3): 299-321.
- Calvo, E., and S. Rubio (2013): "Dynamic Models of International Environmental Agreements: A Differential Game Approach," *International Review of Environmental and Resource Economics* 6(4): 289-339.
- Dutta, P. K., and R. Radner (2004): "Self-enforcing climate-change treaties," *PNAS* 101: 4746-51.
- Dutta, Prajit K. and R. Radner (2009): "A Strategic Analysis of Global Warming: Theory and Some Numbers," *Journal of Economic Behavior & Organization* 71(2): 187-209.
- Harstad, B. (2016): "The Dynamics of Climate Agreements," *Journal of the European Economic Association* 14(3): 719-52.
- Hong, F. and Karp, L. (2012): "International Environmental Agreements with Mixed Strategies and Investment," *Journal of Public Economics* 96(9-10): 685-97.

4. Coalitions: Free Riding vs. Participation

[Lecture Note 2](#)

- Battaglini, M., and B. Harstad (2016): "Participation and Duration of Environmental Agreements," *Journal of Political Economy* 124(1): 160-204.
- Bhaskar, D. and H. Vartiainen (2020): Coalition formation and history dependence, *Theoretical Economics* 15: 159-197.
- Bloch, F. (2018): "Coalitions and networks in oligopolies," *Handbook of Game Theory and Industrial Organization*, ed. by L. Corchon and M. Marini, Edward Elgar.
- Carraro, C., and D. Siniscalco (1993): "Strategies for the international protection of the environment," *Journal of Public Economics* 52(3): 309-28.
- Dixit, A., and M. Olson (2000): "Does voluntary participation undermine the Coase Theorem?" *Journal of Public Economics* 76(3): 309-35.
- Nordhaus, W. D. (2015): "Climate Clubs: Overcoming Free-riding in International Climate Policy," *American Economic Review* 105(4): 1339-70.
- Rey, D. and R. Vohra (2001): "Coalitional Power and Public Goods," *Journal of Political Economy* 109 (6): 1355-84.
- Rey, D. and R. Vohra (2015), "Coalition formation." In *Handbook of Game Theory* (Shmuel Zamir and Petyon Young, eds.): 239–326.

de Zeeuw, A. (2008): "Dynamic effects on the stability of international environmental agreements," *Journal of Environmental Economics and Management* 55(2): 163--74.

5. Compliance and Self-enforcing Agreements

[Lecture Note 3](#)

Barrett, S. (2003): *Environment & Statecraft: The Strategy of Environmental Treaty-Making*, Oxford University Press.

6. Discounting and Time Inconsistency

[Lecture Note 4](#)

Bisin, A., A. Lizzeri, and L. Yariv (2015): "Government Policy with Time Inconsistent Voters." *American Economic Review* 105(6): 1711--37.

Dengler, S., R. Gerlag, S.T. Trautmann, and G. Kuilen (2018): "Climate Policy Commitment Devices". *Journal of Environmental Economics and Management* 92:331-42.

Galperti, S., and B. Strulovici (2017): "A Theory of Intergenerational Altruism." *Econometrica* 85 (4): 1175--218.

Gerlagh, R., and M. Liski (2018): "Consistent Climate Policies." *Journal of the European Economic Association* 16(1): 1--44.

Giglio, S., M. Maggiori, and J. Stroebel (2015): "Very Long-Run Discount Rates." *Quarterly Journal of Economics* 130(1): 1--53.

Gollier, C., and M. L. Weitzman (2010): "How Should the Distant Future Be Discounted When Discount Rates Are Uncertain?" *Economic Letters* 107(3): 350--53.

Gollier, C., and R. Zeckhauser (2005): "Aggregation of Heterogeneous Time Preferences." *Journal of Political Economy* 113(4): 878--96.

Gul, F., and W. Pesendorfer (2001): "Temptation and Self-Control." *Econometrica* 69(6): 1403--35.

Harstad, B. (2020): "Technology and Time Inconsistency," *Journal of Political Economy* 128(7), 2020: 2653-89.

Harstad, B., F. Lancia and A. Russo (2019): "Compliance Technology and Self-Enforcing Agreements," *Journal of the European Economic Association* 17(1):1-30.

Jackson, M.O., and L. Yariv (2015): "Collective Dynamic Choice: The Necessity of Time Inconsistency." *American Economic Journal: Microeconomics* 7(4): 150-78.

Karp, L. (2005): "Global Warming and Hyperbolic Discounting." *Journal of Public Economics* 89: 261-82.

Krusell, P, B. Kuruşçu, and A.A. Smith Jr (2010): "Temptation and Taxation." *Econometrica* 78(6): 2063-84.

Laibson, D. (1997): "Golden eggs and hyperbolic discounting." *Quarterly Journal of Economics* 112(2): 443-78.

Saez-Marti, M., and J. W. Weibull (2005): "Discounting and altruism to future decision-makers." *Journal of Economic Theory* 122: 254-66.

Strotz, R.H. (1956): "Myopia and Inconsistency in Dynamic Utility Maximization." *Review of Economic Studies* 23: 166-80.

Weitzman, M. L. (1998): "Why the Far-Distant Future Should Be Discounted at Its Lowest Possible Rate," *Journal of Environmental Economics and Management*, 36(3): 201-208.

Weitzman, M.L. (2001): "Gamma Discounting." *American Economic Review* 91(1): 260-71.

Political Economics

Austen-Smith, D., B. Harstad, W. Dziuda and A. Loeper (2019): "Gridlock and Inefficient Policy Instruments" *Theoretical Economics* 14(4): 1483–1534.

Bang, G., J. Hovi, and D.F. Sprinz (2012): "US Presidents and the Failure to Ratify Multilateral Environmental Agreements." *Climate Policy* 12(6): 755–63.

Battaglini, M., and Harstad, B. (2020): "The Political Economy of Weak Treaties," *Journal of Political Economy* 128(2): 544–90.

Buchholz, W., A. Haupt, and W. Peters (2005): "International Environmental Agreements and Strategic Voting." *Scandinavian Journal of Economics* 107(1): 175–95.

Dietz, S., C. Marchiori, and A. Tavoni (2012): "Domestic Politics and the Formation of International Environmental Agreements." Working Paper no. 100, *Centre Climate Change Economics and Policy*.

Harstad, B. (2008): "Do Side Payments Help? Collective Decisions and Strategic Delegation." *Journal of the European Economic Association* 6(2–3): 468–77.

Hovi, J., D.F. Sprinz, and G. Bang (2012): "Why the United States Did Not Become a Party to the Kyoto Protocol: German, Norwegian and U.S. Perspectives." *European Journal of International Relations* 18: 129–50.

Maggi, G., and M. Morelli (2006): "Self-Enforcing Voting in International Organizations." *American Economic Review* 96(4): 1137–58.

Segendorff, B. (1998): "Delegation and Threat in Bargaining." *Games and Economic Behavior* 23(2): 266-83.

If we have time: Supply-side Regulation

Bohm, P. (1993): "Incomplete International Cooperation to Reduce CO2 Emissions: Alternative Policies," *Journal of Environmental Economics and Management* 24(3): 258-71.

Elliott, J., I. Foster, S. Kortum, T. Munson, Todd, F.P. Cervantes and D. Weisbach (2010): "Trade and Carbon Taxes," *American Economic Review: Papers & Proceedings* 100(May): 465-9.

- Gerlagh, R. and M. Liski (2011): "Strategic Resource Dependence," *Journal of Economic Theory* 146(2): 699-727.
- Harstad, B. (2012): "Buy Coal! A Case for Supply-Side Environmental Policy," *Journal of Political Economy* 120(1): 77-115.
- Harstad, B. (2016): "The Market for Conservation and Other Hostages," *Journal of Economic Theory* 166(Nov): 124-51.
- Harstad, B. and T. Mideksa (2017): "Conservation Contracts and Political Regimes" *Review of Economic Studies* 84(4): 1708-34.
- Hoel, M. (1994): "Efficient Climate Policy in the Presence of Free Riders." *J. Environmental Econ. And Management* 27(3): 259-74.
- Markusen, James R. (1975): "International externalities and optimal tax structures," *Journal of International Economics* 5(1): 15-29.
- Sinn, H.W. (2008): "International externalities and optimal tax structures," *Journal of International Economics* 5(1): 15-29.

Relevant Books:

- Barrett, S. (2003): *Environment & Statecraft: The Strategy of Environmental Treaty-Making*, Oxford University Press.
- Phaneuf, D.J., and T. Requate (2016): *A Course in Environmental Economics: Theory, Policy, and Practice*, Cambridge University Press.

