

# SYLLABUS

## PPHA 44320: Energy and Environmental Economics I

**Professor Ryan Kellogg**  
**kellogg@uchicago.edu**  
**Office Hours: by appointment**

**Fall 2020**  
**Course time: Thursday, 8:00 – 10:50am Chicago time**  
**Course format: fully remote**

**Please contact my assistant, Lydia Veliko, [lydiav@uchicago.edu](mailto:lydiav@uchicago.edu), for appointments**

PPHA 44320 is the first course in the PhD energy and environmental economics sequence. The second and third courses will be taught by Michael Greenstone and Koichiro Ito. In my course, we will emphasize the fundamental economic aspects of resource production and problems associated with externalities and common property. Most topics will be theoretical in nature, but we will spend considerable time studying applications that have an empirical component.

**Prerequisites:** Successful completion of the PhD micro theory sequence (or equivalent) is a prerequisite for this course. You should also either have or quickly develop a facility with constrained optimization and optimal control theory / dynamic programming. See the Baumol chapter and Olson handouts listed in the week 1 readings, as well as chapter 7 of Hanley, Shogren, and White. The Léonard and van Long text is an excellent resource. You should also have a background in statistics and regression analysis.

**Course objectives:** The course has four complementary objectives: (1) provide a foundation in concepts like Hotelling's Rule and Pigouvian taxation that are a prerequisite for understanding modern environmental and resource economics; (2) build comprehension of frontier research that grapples with these concepts; (3) develop proficiency with theoretical, computational, and empirical tools that will be valuable for future self-directed research; and (4) gain experience in reading, presenting, and discussing modern research in energy and environmental economics.

**Format:** The course will be held entirely remotely, with no physical meetings. Each week will typically involve a combination of pre-recorded lecture and synchronous, live meetings during our scheduled Thursday 8:00 – 10:50 meeting time. Because some content will be covered in the pre-recordings, I expect that we will not use the entire 8:00 – 10:50 time most weeks (though we will always begin class at 8:00am sharp).

I will generally use the pre-recorded lectures to present content that is relatively technical in nature. The pre-recorded modules will include short (non-credit) quizzes that will let you self-assess your comprehension of the material. Each module will also be associated with a discussion forum that you can use to ask questions. Depending on the nature of each question, I might answer it online or save it for discussion during our synchronous meeting. Our synchronous sessions will then be used for answering questions about recorded material, discussion of economic concepts related to the lectures, and student presentation and discussion of selected papers.

## Assignments

With the above course objectives in mind, the course has the following required assignments: (1) in-class presentations and discussions of papers; (2) two problem sets that stress analytical theory; (3) a computational assignment; and (4) a final exam.

The **problem sets** will give you practice in setting up models of natural resource extraction and pollution control, and using those models to answer questions. They are due before class on October 29 and December 3. The computational assignment asks you to set up and solve dynamic resource extraction problems on the computer and is due before class on November 12. For the problem sets and computational assignment, feel free to work with others in the class, though what you turn in must be written / coded up individually.

The **final exam** will be take-home. It will be open book / notes / computer, but you are not permitted to consult with any other person (whether they are in the class or not). I will make the exam available for download on December 4. Once you download the exam, you will have four hours to complete it. You must take the exam by December 8.

The **student presentations** merit a bit more discussion. The course schedule / reading list---given in detail at the end of this syllabus---marks some papers with asterisks. In class, each of these papers will be presented by a student, who will both present the main ideas of the paper as well as their own thoughts and critiques. The paper will then be discussed amongst all of us as a group. (Note: the classic Coase (1960) paper, which is starred on the reading list, will be a group discussion without a presentation.)

My goal for each paper is to have a lively discussion. To this end, my plan and expectations for each paper are laid out below:

- **Main presentation:** The presenting student will present the paper for roughly 25 minutes. The talk should motivate the paper's research question, explain the strategy for answering the question (including why that particular strategy was chosen), and then summarize the paper's results and their implications. Beyond presenting the paper as it was written, the presentation should also "discuss" the paper, as a discussant would at a conference. For instance, the presenter can help frame the importance of the paper within the literature and/or public policy, discuss the paper's strengths and weaknesses, discuss alternative approaches to the research question, and suggest future work (either to address the paper's weaknesses or to extend the paper's conclusions).

Since slides (via Powerpoint or Beamer) are the standard for economics talks these days, I expect them to be used here. During the presentation, audience members can ask clarifying questions, but we should save substantive comments and questions for the group discussion after the presentation. **Presenters should email their slides to me before class.**

- **Audience:** The audience is expected to contribute substantially to a group discussion of the paper following the presentation. Every student is expected to participate. To facilitate dialogue, every student who is not presenting the paper will, **no later than 5:00pm on the evening before class**, post comments about the paper into the discussion forum on the course's Canvas website. The comments should be the equivalent of 1-2 pages of text. Please organize your comments using the following headings:

1. Summary: What do you see as the main takeaways of the paper? What is the paper's contribution? What are the main tools the paper used to reach its conclusions (what is the paper's "lever")?
2. What did you most like about the paper?
3. What did you most dislike? What are some problems you see in the paper?
4. What questions do you have about the paper?

These comments can span issues such as the paper's strategy and results, concerns regarding the paper's strategy / methods, implications of the paper that you think are worth additional attention, parts of the paper that you find confusing, and any ideas for related follow-up research.

During our group discussions, please do not be afraid to bring up any aspects of the paper that you find confusing. Some of the papers we cover are quite complex, and I do not expect you to understand everything that the authors are doing. In some cases, the authors themselves may not fully understand what they are doing, nor may I. I know some of these papers quite well, but there are others with which I am only loosely familiar (since, e.g., they appeared just this past year). So I will be learning with you.

We will assign presenters to papers early in the fall term.

## **Grading**

The course grades will break out as follows

1. **CLASS PARTICIPATION / PRESENTATIONS (40% OF GRADE):** Your participation / presentation grade will be based on your presentations, audience discussions, and the comments you post before class laying out your thoughts on the day's papers. For each paper, I will NOT be grading you on the basis of whether your insights are correct or incorrect. I WILL be grading you on whether you are demonstrating a sincere effort to understand what each of the papers is trying to do, think critically about the papers' methods and conclusions, and contribute to the learning of the class as a whole. Again, I do not expect you to fully understand every aspect of every paper before coming to class—please arrive armed with any questions you have!
2. **PROBLEM SETS (20% OF GRADE):** Full credit if you make a sincere and well-reasoned effort at every problem. I won't go through your answers in detail to check for correctness, but I will post solutions to the problem set against which you should carefully check your work.
3. **COMPUTATIONAL ASSIGNMENT (10% OF GRADE):** Full credit if you make a sincere and well-reasoned effort at every problem. I won't go through your code in detail to check for correctness, but I will post my own code and output against which you should carefully check your work.
4. **EXAM (30% OF GRADE)**

## Textbook

There is no required textbook for the course, as our readings will primarily consist of research papers and, occasionally, book chapters. That said, the following is a good, graduate-level textbook on environmental economics, with an emphasis on theory: Hanley, Shogren, and White, *Environmental Economics in Theory and Practice*, 2nd edition. New York: Palgrave Macmillan (2007).

I recommend Léonard, Daniel and Ngo van Long, *Optimal Control Theory and Static Optimization in Economics*, Cambridge University Press (1992) as a technical resource for the mathematics of optimal control problems.

For computational work, I recommend Judd, Kenneth L, *Numerical Methods in Economics*, MIT Press, 1998, which has thorough coverage of computational approaches for function approximation, non-linear equation solving, dynamic optimization, and so on. Another, more accessible resource is Miranda, Mario J. and Paul L. Fackler, *Applied Computational Economics and Finance*, MIT Press (2002).

## Auditing

I welcome students who choose to audit the course. However, my class is a no-free-rider zone, so auditing students will be required to participate in class presentations and discussions as if they were taking the course for credit. Specifically, auditing students are required to post comments on papers presented by others and participate in class discussions. Auditors may also be asked to present a paper in class. **I will ask auditors to discontinue attendance if they are not contributing to the class discussions.** Auditors are exempt from turning in problem sets and from taking the exam.

## PPHA 44320 Schedule and Readings, Fall 2020

Required readings to be presented and discussed by students are in bold and marked with a (\*). ALL students are required to read the required readings, not just the assigned presenter.

You are not required to read the other papers, but you should read them if you are interested in the topic and are considering related research.

THE SCHEDULE IS CURRENTLY FIRM THROUGH WEEK 3 AND THEN TENTATIVE THEREAFTER. I WILL POST A FINAL SCHEDULE EARLY IN WEEK 2.

### CLASS 1: Thursday, October 1

TOPICS: COURSE INTRODUCTION; PRESENTATION SKILLS

Pfaff, Alexander F. and Robert N. Stavins, "Readings in the Field of Natural Resource and Environmental Economics", working paper (1999).

Shapiro, Jesse M., "How to Give an Applied Micro Talk: Unauthoritative Notes", slide presentation.

### CLASS 2: Thursday, October 8

TOPICS: CONSTRAINED OPTIMIZATION AND DISCRETE-TIME DYNAMIC PROGRAMMING; EXHAUSTIBLE NATURAL RESOURCE PRODUCTION; VALUE FUNCTIONS; GREEN PARADOX

**(\*) Lemoine, Derek, "Green Expectations: Current Effects of Anticipated Carbon Pricing", *Review of Economics and Statistics* 99 (2017), 499-513.**

Baumol, William, "Kuhn-Tucker Methods", in *Economic Theory and Operations Analysis* 4<sup>th</sup> ed., Prentice-Hall (1977) p. 156-176.

Gaudet, Gerard, "Natural Resource Economics Under the Rule of Hotelling", address delivered at the 41<sup>st</sup> annual meetings of the Canadian Economics Association (2007).

Gaudet, Gerard, and Stephen W. Salant, "The Hotelling Model with Multiple Demands", working paper (2013).

Gray, Jo Anna and Stephen W. Salant, "Transversality Conditions in Infinite Horizon Models", International Finance Discussion Paper 172 (1981).

Herfindahl, Orris C., "Depletion and Economic Theory", in *Extractive Resources and Taxation*, Ed. Mason Gaffney, University of Wisconsin Press (1967), pp. 68-90.

Hotelling, Harold, "The Economics of Exhaustible Resources," *Journal of Political Economy* 39 (1931), 137-175.

- Levhari, David and Robert S. Pindyck, "The Pricing of Durable Exhaustible Resources," *Quarterly Journal of Economics* 96 (1981), 365-378.
- Moreno-Cruz, Juan, and M. Scott Taylor, "A Spatial Approach to Energy Economics", working paper (2013).
- Olson, Lars, "Handout: A Review of Dynamic Optimization and Optimal Control Theory"

### **WEEK 3: Thursday, October 15**

TOPICS: CONTINUOUS TIME DYNAMIC PROGRAMMING; CONSTRAINED EXHAUSTIBLE NATURAL RESOURCE PRODUCTION

**(\*) Heal, Geoffrey and Wolfram Schlenker, "Coase, Hotelling, and Pigou: The Incidence of a Carbon Tax and CO2 Emissions", NBER working paper #26086 (2019).**

- Adelman, Morris, "Mineral Depletion, with Special Reference to Petroleum", *Review of Economics and Statistics* 72 (1990), 1-10.
- Anderson, Soren T., Ryan Kellogg, and Stephen W. Salant, "Hotelling Under Pressure", *Journal of Political Economy* 126 (2018), 984-1026.
- Holland, Stephen P. "Modeling Peak Oil", mimeo (2006). (Much shorter version eventually published in *Energy Journal* 29 (2008), 61-80.)
- Newell, Richard G. and Brian C. Prest, "The Unconventional Oil Supply Boom: Aggregate Price Response from Microdata", *Energy Journal* 40 (2019).
- Newell, Richard G., Brian C. Prest, and Ashley Vissing, "Trophy Hunting vs. Manufacturing Energy: The Price-Responsiveness of Shale Gas", *Journal of the Association of Environmental and Resource Economists* 6 (2019), 177-217.
- Pindyck, Robert S., "The Optimal Exploration and Production of Nonrenewable Resources", *Journal of Political Economy* 86 (1978), 841-861.
- Slade, Margaret E. and Henry Thille, "Whither Hotelling: Tests of the Theory of Exhaustible Resources", *Annual Review of Resource Economics* 1 (2009), 239-259.
- Stiglitz, Joseph E., "Monopoly and the Rate of Extraction of Exhaustible Resources," *American Economic Review* 66 (1976), 655-661.

### **WEEK 4: Thursday, October 22**

TOPICS: SOLVING DYNAMIC PROBLEMS ON THE COMPUTER; RESOURCE EXPLORATION; INVESTMENT UNDER UNCERTAINTY; ABOVE-GROUND STORAGE AND SPECULATION

**(\*) Knittel, Christopher R. and Robert S. Pindyck, "The Simple Economics of Commodity Price Speculation", *American Economic Journal: Macroeconomics* 8 (2016), 1-27.**

- Arrow, Kenneth J. and Anthony C. Fisher, "Environmental Preservation, Uncertainty, and Irreversibility", *Quarterly Journal of Economics* 88 (1974), 312-319.
- Black, Fischer, and Myron Scholes. 1973. "The Pricing of Options and Corporate Liabilities." *Journal of Political Economy* 81(3): 637-654.
- Bornstein, Gideon, Per Krussel, and Sergio Rebelo, "Lags, Costs, and Shocks: an Equilibrium Model of the Oil Industry", NBER working paper #23423 (2017).
- Dixit, Avinash K., "Investment and Hysteresis", *Journal of Economic Perspectives* 6 (1992), 107-132.
- Dixit, Avinash K., and Robert S. Pindyck. 1994. *Investment Under Uncertainty*, Princeton, NJ: Princeton University Press.
- Kellogg, Ryan, "The Effect of Uncertainty on Investment: Evidence from Texas Oil Drilling," *American Economic Review* 104 (June, 2014), 1698-1734.
- Lewis, Eric, "Patchwork Policies, Spillovers, and the Search for Oil and Gas", *American Economic Journal: Economic Policy*, forthcoming.
- McDonald, Robert and Daniel Siegel, "The Value of Waiting to Invest", *Quarterly Journal of Economics* 101 (1986), 707-728.
- Paddock, James L., Daniel R. Siegel, and James L. Smith, "Option Valuation of Claims on Real Assets: The Case of Offshore Petroleum Leases", *Quarterly Journal of Economics* 103 (1988), 479-508.
- Pindyck, Robert S. "Irreversibility, Uncertainty, and Investment." *Journal of Economic Literature* 29 (1991), 1110-1148.
- Pindyck, Robert S., "The Dynamics of Commodity Spot and Futures Markets: A Primer", *Energy Journal* 22 (2001), 1-29.
- Salant, Stephen W. and Dale W. Henderson, "Market Anticipations of Government Policies and the Price of Gold", *Journal of Political Economy* 86 (1978), 627-648.
- Salant, Stephen W., "The Vulnerability of Price Stabilization Schemes to Speculative Attack", *Journal of Political Economy* 91 (1983), 1-38.
- Samuelson, Paul A., "Intertemporal Price Equilibrium: A Prologue to the Theory of Speculation", *Weltwirtschaftliches Archiv*. 79 (1957), 181-221.

## **WEEK 5: Thursday, October 29**

TOPICS: RENEWABLE RESOURCES; COMMON POOLS; PIGOUVIAN TAXATION;  
COASE AND ALTERNATIVES TO PIGOUVIAN TAXATION

ASSIGNMENTS: PROBLEM SET 1 DUE

- (\*) (no presentation, but to be read and discussed by all) Coase, Ronald H., "The Problem of Social Cost", *Journal of Law and Economics* III (1960), pp. 1-44.
- (\*) Taylor, M. Scott, "Buffalo Hunt: International Trade and the Virtual Extinction of the North American Bison", *American Economic Review* 101 (Dec., 2011).

- Ayers, Andrew B., Kyle C. Meng, and Andrew J. Plantinga, "Do Property Rights Alleviate the Problem of the Commons? Evidence from California Groundwater Rights", NBER working paper #26268 (2019).
- Banzhaf, H. Spencer, "A History of Pricing Pollution (Or, Why Pigouvian Taxes Are Not Necessarily Pigouvian)", NBER working paper #27683 (2020).
- Baumol, William J., "On Taxation and the Control of Externalities", *American Economic Review* 62 (1972), 307-322.
- Dasgupta, P.S. and G.M. Heal, "Externalities", in *Economic Theory and Exhaustible Resources*. Cambridge University Press (1979), 55-78.
- Deacon, Robert T., Dominic P. Parker, and Christopher Costello, "The Efficiency Gains from Coordinating Use of a Shared Resource: Evidence from a Self-Selected Fishery Coop" *Journal of Law and Economics* 56 (2013), pp. 83-125.
- Gordon, H. Scott, "The Economic Theory of a Common-Property Resource: The Fishery", *Journal of Political Economy* 62 (1954), 124-142.
- Harstad, Bard, "Buy Coal! A Case for Supply-Side Environmental Policy", *Journal of Political Economy* 120 (2012), 77-115.
- Libecap, Gary D., "Addressing Global Environmental Externalities: Transactions Cost Considerations", NBER working paper 19501 (2013).
- Libecap, Gary D., "Coasean Bargaining to Address Environmental Externalities", NBER working paper #21903 (2016).
- Libecap, Gary D. and Steven N. Wiggins, "Contractual Responses to the Common Pool: Prorating of Crude Oil Production", *American Economic Review* 74 (1984), 87-98.
- Libecap, Gary D. and Steven N. Wiggins, "The Influence of Private Contractual Failure on Regulation: The Case of Oil Field Unitization", *Journal of Political Economy* 93 (1985), 690-714.
- Ostrom, Elinor, *Governing the Commons: The Evolution of Institutions for Collective Action (Political Economy of Institutions and Decisions)*, Cambridge University Press (1990).
- Pigou, Arthur C., *The Economics of Welfare*. London: Macmillan (1920).
- Usher, Dan, "The Coase theorem is tautological, incoherent, or wrong", *Economics Letters* 11 (1998), 3-11.
- Wiggins, Steven N. and Gary D. Libecap, "Oil Field Unitization: Contractual Failure in the Presence of Imperfect Information", *American Economic Review* 75 (1985), 368-385.



## WEEK 6: Thursday, November 5

TOPICS: COMMON POOLS; PRICE VS. QUANTITY STANDARDS; ECONOMICS OF TRADEABLE EMISSION PERMITS AND QUANTITY STANDARDS

(\*) **Bushnell, James B., Howard Chong, and Erin T. Mansur, “Profiting from Regulation: Evidence from the European Carbon Market”, *American Economic Journal: Economic Policy* 5 (2013), 78-106.**

(\*) **Ryan, Nicholas and Anant Sudarshan, “Rationing the Commons”, NBER working paper #27473 (2020).**

Borenstein, Severin, James Bushnell, Frank A. Wolak, and Matthew Zaragoza-Watkins, “Expecting the Unexpected: Emissions Uncertainty and Environmental Market Design”, *American Economic Review* 109 (2019), 3953-3977.

Bushnell, James B., “The Economics of Carbon Offsets”, in *The Design and Implementation of U.S. Climate Policy*, Don Fullerton and Catherine Wolfram, editors. University of Chicago Press (2012).

Ellerman, A. Denny, “Ex Post Evaluation of Tradeable Permits: The U.S. SO<sub>2</sub> Cap-and-Trade Program”, MIT working paper 03-003 (2003).

Goulder, Lawrence H. and Andrew Schein, “Carbon Taxes vs. Cap and Trade: A Critical Review”, *Climate Change Economics* 4 (2013).

Hasegawa, Makoto, and Stephen Salant, “Cap-and-trade Programs Under Delayed Compliance: Consequences of Interim Injections of Permits”, *Journal of Public Economics* 119 (2014), 24-34.

Kaplow, Louis, “Taxes, Permits, and Climate Change,” NBER working paper #16268 (2010).

Kaplow, Louis, and Steven Shavell, “On the Superiority of Corrective Taxes to Quantity Regulation,” *American Law and Economics Review*, 4 (2002), 1-17.

Kellogg, Ryan, “Gasoline Price Uncertainty and the Design of Fuel Economy Standards”, *Journal of Public Economics* 160 (2018), 14-32.

Malcomson, James M., “Prices vs. Quantities: A Critical Note on the Use of Approximations,” *Review of Economic Studies* 45 (Feb., 1978), 203-207.

Millock, Katrin, David Sunding, and David Zilberman, “Regulating Pollution with Endogenous Monitoring”, *Journal of Environmental Economics and Management* 44 (2002), 221-241.

Montero, Juan-Pablo, “Voluntary Compliance with Market-Based Environmental Policy: Evidence from the U.S. Acid Rain Program”, *Journal of Political Economy* 107 (1999), 998-1033.

Montero, Juan-Pablo, “Optimal Design of a Phase-in Emissions Trading Program”, *Journal of Public Economics* 75 (2000), 273-291.

Montero, Juan-Pablo, “Pollution Markets with Imperfectly Observed Emissions”, *RAND Journal of Economics* 36 (2005), 645-660.

Pizer, William A. and Brian Prest, “Prices Versus Quantities with Policy Updating,” *Journal of the Association of Environmental and Resource Economists*, forthcoming.

Schmalensee, Richard and Robert Stavins, “Lessons Learned from Three Decades of Experience with Cap-and-Trade”, NBER working paper 21742 (2016).

- Segerson, Kathleen, "Uncertainty and Incentives for Nonpoint Pollution Control", *Journal of Environmental Economics and Management* 15 (1988), 87-98.
- Spulber, Daniel F., "Optimal Environmental Regulation Under Asymmetric Information", *Journal of Public Economics* 35 (1988), 163-181.
- Usher, Dan, "The Coase Theorem is Tautological, Incoherent, or Wrong," *Economics Letters* 61 (1998), 3-11.
- Weitzman, Martin L., "Prices vs. Quantities," *Review of Economic Studies* 41 (Oct., 1974), 477-491.
- Weitzman, Martin L., "Reply to 'Prices vs. Quantities: A Critical Note on the Use of Approximations'," *Review of Economic Studies* 45 (Feb., 1978), 209-210.

## **WEEK 7: Thursday, November 12**

TOPICS: FINISH PRICE VS QUANTITY STANDARDS; TARGETING; INTENSITY STANDARDS

ASSIGNMENTS: COMPUTATIONAL ASSIGNMENT DUE

- (\*) **Jacobsen, Mark R., Christopher R. Knittel, James M. Sallee, and Arthur A. van Benthem, "The Use of Regression Statistics to Analyze Imperfect Pricing Policies", *Journal of Political Economy*, forthcoming.**
- (\*) **Ito, Koichiro and James M. Sallee, "The Economics of Attribute-Based Regulation: Theory and Evidence from Fuel-Economy Standards", *Review of Economics and Statistics* 100 (May, 2018), 319-336.**
- Holland, Stephen P., Jonathan E. Hughes, and Christopher R. Knittel, "Greenhouse Gas Reductions Under Low Carbon Fuel Standards?" *American Economic Journal: Economic Policy* 1 (2009), 106-146.
- Diamond, Peter A., "Consumption Externalities and Imperfect Corrective Pricing", *Bell Journal of Economics and Management Science* 4 (1973), 526-538.
- Kellogg, Ryan, "Output and Attribute-Based Carbon Regulation Under Uncertainty", *Journal of Public Economics* (forthcoming).

## **WEEK 8: Thursday, November 19**

TOPICS: ATTRIBUTE-BASED STANDARDS; POLLUTION CONTROL IN SECOND BEST SETTINGS: MARKET POWER AND LEAKAGE

- (\*) **Holland, Stephen P., "Taxes and Trading Versus Intensity Standards: Second-Best Environmental Policies With Incomplete Regulation (Leakage) or Market Power," *Journal of Environmental Economics and Management* 63 (2012), 375-387.**
- (\*) **Preonas, Louis, "Market Power in Coal Shipping and Implications for U.S. Climate Policy", working paper (2018).**

- Baylis, Kathy, Don Fullerton, and Daniel H. Karney, "Negative Leakage", *Journal of the Association of Environmental and Resource Economists* 1 (2014), 51-73.
- Buchanan, James M., "External Diseconomies, Corrective Taxes, and Market Structure," *American Economic Review* 59 (1969), 174-177.
- Fischer, Carolyn and Stephen W. Salant, "Limits to Limiting Greenhouse Gases: Intertemporal Leakage, Spatial Leakage, and Negative Leakage", working paper (2013).
- Fowlie, Meredith, Mar Reguant, and Stephen P. Ryan, "Market-Based Emissions Regulation and Industry Dynamics," *Journal of Political Economy* 124 (2016), 249-302.
- Ganapati, Sharat, Joseph S. Shapiro, and Reed Walker, "The Incidence of Carbon Taxes in U.S. Manufacturing: Lessons from Energy Cost Pass-Through", *American Economic Journal: Applied Economics*, forthcoming.
- Hahn, Robert W., "Market Power and Transferable Property Rights," *Quarterly Journal of Economics* 99 (Nov., 1984), 753-765.
- Martin, Ralf, Mirabelle Muûls, Laure B. de Preux, and Ulrich J. Wagner, "Industry Compensation Under Relocation Risk: A Firm-Level Analysis of the EU Emissions Trading Scheme", *American Economic Review* 104 (2014), 2482-2508.

## WEEK 9: Thursday, December 3

TOPICS: POLLUTION CONTROL IN SECOND BEST SETTINGS: TAX AND REGULATORY DISTORTIONS; REDISTRIBUTION

ASSIGNMENTS: PROBLEM SET 2 DUE

- (\*) **Borenstein, Severin and James Bushnell, "Do Two Electricity Pricing Wrongs Make a Right? Cost Recovery, Externalities, and Efficiency" Energy Institute at Haas working paper #294 (2018).**
- (\*) **Sallee, James M., "Pigou Creates Losers: On the Implausibility of Achieving Pareto Improvements from Efficiency-Enhancing Policies", working paper (2019).**
- Davis, Lucas W., and Erich Muehlegger, "Do Americans Consume Too Little Natural Gas? An Empirical Test of Marginal Cost Pricing," *RAND Journal of Economics* 41 (2010), 791-810.
- Fullerton, Don, and Sarah E. West, "Tax and Subsidy Combinations for the Control of Car Pollution", *B.E. Journal of Economic Analysis and Policy: Advances* 10 (2010), article 8.
- Goulder, Lawrence H., Ian W.H. Parry, and Dallas Burtraw, "Revenue-Raising Versus Other Approaches to Environmental Protection: The Critical Significance of Pre-Existing Tax Distortions," *RAND Journal of Economics* 28 (Winter, 1997), 708-731.
- Goulder, Lawrence H., Ian W.H. Parry, Roberton C. Williams III, and Dallas Burtraw, "The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting," *Journal of Public Economics* 72 (1999), 329-360.
- Goulder, Lawrence H. and Roberton C. Williams III, "The Substantial Bias from Ignoring General Equilibrium Effects in Estimating Excess Burden, and a Practical Solution", *Journal of Political Economy* 4 (2003), 898-927.

Reguant, Mar, “The Efficiency and Sectoral Distributional Impacts of Large-Scale Renewable Policies”, *Journal of the Association of Environmental and Resource Economics*, forthcoming.

Sherman, Roger and Michael Visscher, “Rate-of-Return Regulation and Two-Part Tariffs”, *Quarterly Journal of Economics* 97 (1982), 27-42.

West, Sarah E. and Roberton C. Williams III, “Optimal Taxation and Cross-Price Effects on Labor Supply: Estimates of the Optimal Gas Tax,” *Journal of Public Economics* 91 (2007), 593-617.

Williams, Roberton C. III, “Environmental Taxation”, NBER working paper #22303 (2016).