

Advanced Natural Resource Economics

AREc 651

Winter Term 2008

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Course Description: This is a PhD level course in natural resource economics. The first part of the course is devoted to a review of dynamic optimization techniques and the application of these methods to problems of renewable and nonrenewable resource use. In each case, we develop the basic theoretical model and then consider extensions and applications. During the latter part of the course, we consider a number of topics related to land resources and, lastly, we conclude with a study of optimal resource use under uncertainty.

Prerequisites: AREc/Econ 513 and 526, or equivalent

Credits: 3

Readings: The main textbook for this course is Conrad and Clark (1987). Journal articles and portions of textbooks will be used as supplemental readings.

Grading: Your grade will be based on a mid-term exam (30%), a comprehensive final exam (40%), and class participation (30%). You will be required to give in-class presentations of journal articles (the number of presentations will depend on the class size). Exams will cover material presented in class, assigned readings, and homework assignments.

Class Meetings: TTh, 8:30 – 9:50, Ballard 118

Class Schedule

Topic

Reading

Weeks 1 and 2 (January 8, 10, 15, 17)

Introduction and Dynamic Optimization Techniques

(Lagrangian methods, discrete and continuous time Hamiltonians, fixed- and free-time problems, transversality conditions, infinite horizon problems, bang-bang solutions, phase diagrams, dynamic programming)

C&C, Chapter 1

Week 3 (January 22, 24)

C&C, Chapter 2

Basic Models of Renewable Resources

(fisheries model, private and open access fisheries, forestry models)

Week 4 (January 29, 31)

Basic Models of Renewable Resources (Continued)

Extensions of Renewable Resource Models

Growing demand for stock externalities
Large-scale ecological change

Berck, 1981
Sohngen and Mendelsohn, 1998

Week 5 (February 5, 7)

Extensions of Renewable Resource Models (Continued)

Joint production of timber and biodiversity
Political economy of regulated fisheries

Nalle et al., 2004
Johnson and Libecap, 1982

Mid-term exam (February 7)

Week 6 (February 12, 14)

Basic Nonrenewable Resource Model

(Hotelling principle)

C&C, Chapter 3

Extensions of the Nonrenewable Resource Model

Intergenerational equity
Ownership risk and use of natural resources

Hartwick, 1977
Bohn and Deacon, 2000

Week 7 (February 19, 21)

Applications of the Nonrenewable Resource Model

Empirical tests of the Hotelling model

Halverson and Smith, 1991
Lin and Wagner, 2007

Land Resources

Measuring biodiversity
Wetlands depletion

Solow et al., 1993
Stavins and Jaffe, 1990

Week 8 (February 26, 28)

Land Resources (continued)

Carbon sequestration
Impacts of climate change on agriculture

Lubowski et al., 2006
Schenkler and Roberts, 2006

Dynamic Optimization Under Uncertainty
(stochastic processes, Ito's lemma, stochastic dynamic programming)

Dixit and Pindyck, 1994

Week 9 (March 4, 6)

Dynamic Optimization Under Uncertainty (Continued)

Optimal Resource Use Under Uncertainty

Renewable resource markets and uncertainty
Optimal exploitation of oil reserves

Pindyck, 1984
Conrad and Kotani, 2005

Week 10 (March 11, 13)

Fisheries regulation under uncertainty
Efficient timber prices
Species extinction
Empirical analysis of optimal resource use

Weitzman, 2002
McGough et al., 2004
Fisher and Hanemann, 1986
Provencher, 1995

Final examination (Wednesday, March 19, 6:00 pm)

Reading List

- Berck, P. 1981. Optimal Management of Renewable Resources with Growing Demand for Stock Externalities. *Journal of Environmental Economics and Management* 8(2):105-17.
- Bohn, H., and R.T. Deacon. 2000. Ownership Risk, Investment, and the Use of Natural Resources. *American Economic Review* 90(3):526-549.
- Conrad, J.M., and C.W. Clark. 1987. *Natural Resource Economics: Notes and Problems*. Cambridge University Press.
- Conrad, J.M., and K. Kotani. 2005. When to Drill? Trigger Prices for the Arctic National Wildlife Refuge. *Resource and Energy Economics* 27:273-86.
- Dixit, A.K., and R.S. Pindyck. 1994. *Investment Under Uncertainty*. Princeton University Press.
- Fisher, A.C., and W.M. Hanemann. 1986. Option Value and the Extinction of Species. *Advances in Applied Microeconomics* 4:169-90.
- Halverson, R., and T.R. Smith. 1991. A Test of the Theory of Exhaustible Resources. *Quarterly Journal of Economics* 106(1):123-40.
- Hartwick, J.M. 1977. Intergenerational Equity and the Investing of Rents from Exhaustible Resources. *American Economic Review* 67(5):972-74.
- Johnson, R.N., and G.D. Libecap. 1982. Contracting Problems and Regulation: The Case of the Fishery. *American Economic Review* 72(5):1005-1022.
- Lin, C., and G. Wagner. 2007. Steady-state Growth in a Hotelling Model of Resource Extraction. *Journal of Environmental Economics and Management* 54:68-83.
- Lubowski, R.N., Plantinga, A.J., and R.N. Stavins. 2006. Land-Use Change and Carbon Sinks: Econometric Estimation of the Carbon Sequestration Supply Function. *Journal of Environmental Economics and Management* 51(2):135-52.
- McGough, B., Plantinga, A.J., and B. Provencher. 2004. The Dynamic Behavior of Efficient Timber Prices. *Land Economics* 80(1):94-107.
- Nalle, D.J., Montgomery, C.A., Arthur, J.L., Polasky, S., and N.H. Schumaker. 2004. Modeling Joint Production of Wildlife and Timber. *Journal of Environmental Economics and Management* 48(3):997-1017.
- Pindyck, R.S. 1984. Uncertainty in the Theory of Renewable Resource Markets. *Review of Economic Studies* 51(2):289-303.
- Provencher, B. 1995. Structural Estimation of the Stochastic Dynamic Decision Problems of Resource Users: An Application to the Timber Harvest Decision. *Journal of Environmental Economics and Management* 29:321-38.
- Schlenker, W., and M.J. Roberts. 2006. Estimating the Impact of Climate Change on Crop Yields: The Importance of Non-Linear Temperature Effects. Working paper, Department of Economics, Columbia University.
- Solow, A., Polasky, S., and J. Broadus. 1993. On the Measurement of Biological Diversity. *Journal of Environmental Economics and Management* 24(1):60-68.
- Sohngen, B., and R. Mendelsohn. 1998. Valuing the Impact of Large-Scale Ecological Change in a Market: The Effect of Climate Change on U.S. Timber. *American Economic Review* 88(4):686-710.
- Stavins, R.N., and A.B. Jaffe. 1990. Unintended Impacts of Public Investment on Private Decisions: The Depletion of Forested Wetlands. *American Economic Review* 80(3):337-52.
- Weitzman, M.L. 2002. Land Fees vs Harvest Quotas with Uncertain Fish Stocks. *Journal of Environmental Economics and Management* 43:325-38.