Final Report

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UNIVERSITY OF CALIFORNIA SANTA BARBARA

Title: "Climate Variability, Stochasticity and Learning in Integrated Assessment Models"

PI: Prof. Charles D. Kolstad, Department of Economics, UCSB

Start Date: 9/15/1996

End Date: 9/14/1999

Objective:

The focus of the work has been on climate variability and learning within computational climate-economy models (integrated assessment models -- IAM's).

The primary objective of the research is to improve the representation of learning in IAM's. This includes both endogenous and exogenous learning. A particular focus is on Bayesian learning about climate damage. A secondary objective is to improve the representation of climate variability within IAM's.

Approach/Tasks:

This project is divided into four separate tasks.

(1) Learning about damage with stochastic technology

This task concerns the problem of observing and measuring climate damage. Climate change may tend to depress economic activity whereas innovation and technical progress will increase economic output, disguising the signal. The goal is to represent this learning process within a Ramsey growth model.

(2) Learning about damage and climate sensitivity

This task is an extension of task 1 to include learning about climate sensitivity as well as damage.

(3) Extensions to climate variability

This task includes extending the representation of damage to more than simply mean temperature.

(4) R&D and purchased information

This task seeks to move from endogenous Bayesian learning to active learning, particularly the purchase of R&D and other information.

Results to Date:

In sum, this project has succeeded in improving the representation of learning

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and climate variability within integrated assessment models.

Our goals were attained on three of the four projects. In task #1, we were able to implement the representation of learning about climate sensitivity within a dynamic IAM, although we were unable to represent learning about damage, primarily due to problem size. This work is reflected in several of the publications listed below. On task #3, we made a great deal of progress in quantifying how climate variability enters into damage, primarily through an examination of learning in agriculture. On task #4, we were able to better represent the process of induced technical change within a prototype IAM. This has formed the foundation for the dissertation of G. Mitchell.

Deliverables:

Papers prepared/published:

David Kelly, Charles Kolstad and Glenn Mitchell, "Adjustment Costs from Environmental Change Induced by Incomplete Information and Learning" (June 1999).

Charles Kolstad, Elena Gorbacheva, Julia Khaleeva and Svetlana Shcherbich, "Environmental Economics in Russia: Valuation and Regulatory Distortions" NES Report, Moscow (Nov 1998).

David Kelly and Charles Kolstad, "Solving Growth Models with an Environmental Sector" (July 1999), forthcoming, *J. Computational Economics*.

David Kelly and Charles Kolstad, "Malthus and Climate Change: Betting on a Stable Population" (July 1998), forthcoming, *J. Env. Econ. and Mgmt.*

David Kelly, Charles Kolstad, Michael Schlesinger and Natalia Andronova, "Learning about Climate Sensitivity from the Instrumental Temperature Record," working paper (June 1999).

Charles Kolstad, "Energy and Depletable Resources: Economics and Policy, 1973-98," *J. Env. Econ. and Mgmt.* (forthcoming).

Charles Kolstad and Rolando Guzman, "Information and the Divergence Between Willingness-to-accept and Willingness-to-pay," *J. Env. Econ. and Mgmt.*, **38**:66-80 (1999).

Charles Kolstad and David Kelly, "Bayesian Learning, Growth and Pollution," *J. Econ. Dyn. And Control*, **23**:491-518 (1999).

R. Deacon, D. Brookshire, A. Fisher, A. Kneese, C. Kolstad, D. Scrogin, V. Smith, M. Ward and J. Wilen "Research Trends and Opportunities in Environmental and Resource Economics," *Environmental and Resource Economics*, **11**:383-97

(1998).

David Kelly and Charles Kolstad, "Integrated Assessment Models for Climate Change Control," Ch 4, pp 171-97 in H. Folmer and T. Tietenberg (Eds.), *International Yearbook of Environmental and Resource Economics 1999/2000: A Survey of Current Issues* (Edward Elgar, Cheltenham, UK, 1999).

Charles Kolstad, "Integrated Assessment Modelling of Climate Change," in W.D. Nordhaus (Ed), *Economics and Policy Issues in Climate Change* (Resources for the Future, Washington, DC, 1998).

Charles Kolstad, *Spatial Environmental and Resource Economics*, forthcoming, Edward Elgar, Cheltenham, UK.

David Kelly, "On Kuznets Curves Arising From Stock Externalities," working paper, University of Miami (January 1998).

David Kelly, "Unit Roots in the Climate: Is the Recent Warming Due to Persistent Shocks?" working paper, University of Miami (August 1998).

David Kelly and Douglas Steigerwald, "An Economic Model of Conditional Heteroskedasticity," working paper, University of California, Santa Barbara (January 1998).

Shawn Knabb, "Why Do Firms Undertake Pollution Abatement R&D?," dissertation chapter draft (1999).

Gregory Hunter, "Efficient Public Goods Provision with Incomplete Markets," draft dissertation chapter (1999).

Glenn Mitchell, "Emissions taxes, abatement, and price-induced technical change," draft dissertation chapter (1999).

Presentations:

Greg Hunter, Western Economics Association (1998)

Glenn Mitchell, Western Economics Association (1999)

Glenn Mitchell, California Environmental Economics Workshop (1998)

Glenn Mitchell, National Bureau of Economic Research, Boston (1999)

David Kelly, Econometric Society, Chicago (1998)

David Kelly, University of California, Santa Barbara (1997)

David Kelly, Energy Modelling Forum, Stanford (1998)

David Kelly, University of Aarhus (1998)

David Kelly, University of Miami (1998)

David Kelly, North Carolina State (1998)

David Kelly, University of Tennessee (1998)

Charles Kolstad, Stanford University (1999)

Charles Kolstad, Electric Power Research Institute Workshop on Planning Under Uncertainty (1999).

Charles Kolstad, Center for Operations Research and Econometrics, Catholic University of Louvaine-la-Neuve (1998)

Charles Kolstad, Catholic University of Leuven (1998)

Charles Kolstad, Snowmass Workshop on Integrated Assessment (1997, 1998, 1999).

Charles Kolstad, National Bureau of Economic Research (1999)

Charles Kolstad, Duke University (1997)

Charles Kolstad, Oregon State University (1997)

Charles Kolstad, University of California, Berkeley (1997)

Charles Kolstad, University of Colorado (1997)

Charles Kolstad, Workshop on Climate Change, University of Toulouse (1999)

Charles Kolstad, International Association of Energy Economics, Delhi (1997)

Charles Kolstad, IIASA Workshop in Induced Technical Change (1999)

Charles Kolstad, NBER Workshop on Instruments, Milan (1999)

Collaborations:

Prof. Michael E. Schlesinger, Dept. of Atmospheric Sciences, University of Illinois, Urbana, Illinois.

Postdocs Supported:

Dr. David Kelly (currently Assistant Professor of Economics, University of Miami).

Graduate Students Supported:

Edmund Balsdon, Glenn Mitchell, Jessica Glatzer, Greg Hunter, Shawn Knabb