



Ruhr Graduate School in Economics  
University of Duisburg-Essen  
Essen, Germany, March 28-April 1, 2011

## **7th Ruhr Graduate Summer School**

# **Overlapping Regulation in Energy and Climate Policy with GAMS and MPSGE**

### ***Instructors***

Professor Dr. Christoph Böhringer, University of Oldenburg, Germany  
Professor Dr. Volker Clausen, University of Duisburg-Essen, Germany

### ***Objectives***

Climate policies rank high on the agenda of many countries. A common feature of implemented or suggested climate policies is the use of multiple instruments such as emission taxes, tradable emission allowance, efficiency standards, or promotion schemes for renewable energy. A mix of policy instruments in order to pursue the single policy objective of greenhouse emission reduction is likely to create substantial additional costs which in turn may lower public support for ambitious climate protection strategies. On the other hand, these additional costs may be interpreted as the price tag for other policy objectives (beyond emission reduction) such as energy security, unemployment reduction or strategic structural (industrial) policies.

The workshop provides an analytical framework for assessing the economic trade-offs of overlapping regulation in climate policy. Starting from theoretical considerations we develop quantitative partial and general equilibrium models to quantify the economic implications of multiple policy instruments. The primary field of applied analysis will be the more recent EU Energy and Climate Policy Package which combines the use of EU-wide emission trading for energy-intensive sectors with domestic emission taxes, renewable quotas, efficiency standards and numerous other command-and-control measures.

The workshop will lay out how different regulatory instruments can be implemented within state-of-the-art numerical models and discuss in detail the interaction of these instruments. The analysis will follow peer-reviewed papers on overlapping regulation to be replicated and extended by the participants. Major topics involve the interaction of emission taxes with emission trading, the implications of combined quotas for emission and renewable energy. Transition from sector-specific models (e.g. electricity market models) towards macroeconomic computable general equilibrium (CGE) models allows for the economy-wide trade-off analysis between multiple objectives such as emission reduction or energy security.

The teaching technique we will follow consists of three steps repeated each half day: (1) a brief lecture, (2) examination and discussion of techniques via the use of simple template models, (3) exercises for the participants. Both instructors are available during the entire workshop.

## **Background of Instructors**

**Christoph Böhringer**  
University of Oldenburg

*Christoph Böhringer* is Professor of Economic Policy at the University of Oldenburg. His research for the last years has focused on the quantitative analysis of environmental and energy policies based on numerical optimization models. Since 1994, he has been regularly conducting workshops on applied analysis in the fields of environmental, energy, fiscal and trade policies. He has widely published in international journals, including Applied Economics, Canadian Journal, Computational Economics, Ecological Economics, Energy Economics, Energy Journal, Energy Policy, Environmental and Resource Economics, European Economic Review, European Journal of Political Economy, Journal of Economic Dynamics and Control, Journal of Environmental Economics and Management, Journal of Policy Modeling, Journal of Regulatory Economics, Kyklos, Oxford Review of Economic Policy, The World Economy.

**Volker Clausen**  
University of Duisburg-Essen, Campus Essen

*Volker Clausen* is Professor of International Economics, University of Duisburg-Essen, Campus Essen since 2001. Previously he worked at the Universities of Kiel and Bonn in Germany and at Indiana University, in Bloomington, Indiana (USA). He holds a Ph.D. in Economics from the University of Kiel, Germany, and a Master of Science in Economics from the London School of Economics and Political Science. His current research interests include general equilibrium modeling with a focus on ageing in open economies and also in development economics. His publications have a focus on international topics and appeared in, among others, Journal of International Money and Finance, Journal of Economic Integration and Review of World Economics.

## **Course Coordinator**

Zoryana Olekseyuk-Viber  
University of Duisburg-Essen, Campus Essen

## **Workshop Topics and Schedule**

Day 1: March 28, Monday

### **Introduction to General Equilibrium Modeling: Some Basics**

- Welcome and overview
- Installation of software
- Getting started with GAMS and MCP
- Formulating economic equilibrium as a Mixed Complementarity Problem (MCP)
- *Hands-on session:* Assessing the effects of taxation

Day 2: March 29, Tuesday

### **Mixed Complementarity in Economic Analysis**

- *Hands-on session:* Marginal cost pricing with asymmetric cross-price elasticities for energy
- *Hands-on session:* Strategic behavior in electricity markets.
- Reduced form models of emission abatement based on marginal abatement cost curves
- *Hands-on session:* The cost of EU climate policies for multiple emission markets (EU emission trading market, domestic markets for sectors outside the EU emission trading system, CDM markets)
- *Hands-on session:* Strategic partitioning of national emission markets
- Emission trading in EU electricity markets: A spatial price equilibrium model of the EU electricity market

Day 3 – March 30, Wednesday

### **Partial Equilibrium Analysis of Overlapping Regulation**

- Theoretical impact analysis of overlapping instruments (taxes, permits, green quotas, standards)
- *Hands-on session:* The efficiency losses of additional emission taxes in emission trading systems
- *Hands-on session:* Green promotes the dirtiest - on the interaction between black and green quotas in energy markets
- *Hands-on session:* Greening the electricity system more than necessary – the excess cost of additional green quotas in climate policy

Day 4 – March 31, Thursday

### **General Equilibrium Analysis**

- Applied general equilibrium modeling: “Opening a black box”
- Calibration of functional forms to observed economic data
- *Hands-on session:* Stylized CGE models formulated as MCP
- Introduction to MPSGE: a meta-language under GAMS for efficient implementation of (large-scale) CGE models
- *Hands-on session:* Stylized CGE models implemented with MPSGE

Day 5 – April 1, Friday

### **General Equilibrium Analysis of Climate Policies**

- Bottom-up representation of power supply options in a CGE model
- *Hands-on session:* green quotas and subsidies for renewables
- *Hands-on session:* nuclear phase-out
- *Hands-on session:* carbon emission constraints (carbon taxes) and environmental tax reform
- *Hands-on session:* overlapping green and black quotas

*Note:* Depending on the previous experience of participants with GAMS, MPSGE and CGE modeling, the program might be covered more quickly at the beginning of the workshop which allows for more discussion and implementation of recent research toward the end of the workshop. This will be decided on the basis of the actual list of participants who will be asked about their previous experience in the field before the workshop starts.

## ***Times and Location***

Morning sessions will begin at 9am. Lunch is provided for workshop participants at noon. The afternoon sessions will run from about 1-4pm. Between 4 and 5 pm there will be time for further individual programming and consultation. All sessions take place in the Casino Gästehaus located in the east of the University of Duisburg-Essen, [Campus Essen](#):

*University of Duisburg-Essen, Campus Essen  
Universitätsstraße 12  
45117 Essen  
Germany*

## ***Payment and Registration***

The fee for participating in the training workshop is 2,500 Euro and includes lectures, course material and lunches. **Participants are required to bring a laptop with a DVD drive. Adapters to German power supply if necessary. The GAMS workshop licence (valid for 2 months) as well as extensive course material will be provided on DVDs and CDs.**

Academic participants from accredited universities or research institutions will be admitted on a space-available basis for a discount of 20%. Graduate students from accredited academic institutions are likewise admitted on a space-available basis for a discount of 50%. Please fax or email a copy of your student ID to get the discount. There will be a limited number of scholarships (*excluding travel and subsistence expenses*) that have been set aside for qualified participants from developing countries. Deadline for the application for a scholarship is **January 14, 2011**. Preference will be given to applicants who have documented previous experience in general equilibrium modeling with GAMS. To apply for a scholarship in the form of a tuition waiver, send your CV and a research paper via email to Zoryana Olekseyuk-Viber. A decision on the allocation of scholarships will be made until **January 22, 2011**, in order to allow for an early arrangement of flights, visa etc.

To register by phone, fax, or e-mail, contact:

*Course Coordinator  
Zoryana Olekseyuk-Viber  
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The registration deadline is **March 1, 2011**. The maximum number of participants is restricted to 16.

**Slots are guaranteed only upon full payment of fees through the GAMS Course Coordinator.** Cancellations will be fully refunded if made prior to March 1, 2011. No refunds will be made after the registration deadline.

*Note the following disclaimer and limited liability:* The program and the list of instructors are confirmed and correct at the time of publication. In case of any serious circumstances or acts of nature beyond control of the organizers, such as for example illness, death, cancellation of flights etc., the organizers aim for an adequate substitution. In the very unlikely, but still possible case, the maximum liability of the organizers is limited to the tuition. The organizers do not cover any other costs of the participants, such as travel bookings, visa fees etc.

## **Venue and Accommodation**

**Workshop participants must make their own arrangements for accommodation.** The workshop will be held at the Department of Economics at the University of Duisburg-Essen, Campus Essen: University of Duisburg-Essen, Campus Essen, Universitätsstraße 12, 45117 Essen, Germany. Venue information will be provided after reservation.

Information on nearby hotels and links to maps of Essen can be found [here](#).

Some rooms have been earmarked until the **end of February** 2011 at:

*Bildungshotel im Bfz-Essen e.V., Karolingerstraße 93, 45145 Essen, T: 0201/3204-243, F: 0201/3204-277, [bildungshotel@bfz-essen.de](mailto:bildungshotel@bfz-essen.de), [http://www.bildungshotel-essen.de/zimmer\\_e.htm](http://www.bildungshotel-essen.de/zimmer_e.htm) approx. 43€ per night. (Breakfast available, then add 8,50€)*

Very close to the university is the following hotel:

*Welcome Hotel(\*\*\*\*), Schützenbahn 58, 45127 Essen, T: +49 201 1779-0, F: +49 201 17 79-199, <http://www.welcome-to-essen.de/>, approx. 130€ per night.*

Slightly further away and somewhat less expensive:

*Ibis Hotel Essen (\*\*\*) , Hollestrasse 50, 45127 Essen/Germany, +49/201/24280, <http://www.ibishotel.com/ibis/index.html>, approx. 70€ per night; (Breakfast available, then add 10€).*

## ***How to Prepare***

No previous knowledge of GE modeling is assumed. Participants should be familiar with intermediate microeconomics and get acquainted beforehand with GAMS which is the (rather intuitive) programming language used for computer-based model implementation. Some introductory readings and a short do-it-yourself GAMS tutorial will be sent with further workshop information via email to participants in mid-February 2011.

Workshop participants can do a number of things to prepare for the workshop. Here are some suggestions:

- Download the [GAMS User's Guide](#).
- [Download](#) the Demonstration Version of GAMS. The GAMS software including a workshop license will be provided on the first day of the workshop.
- Study background material provided over the web, including the [MPSGE home page at GAMS](#).

Additional reading materials include:

- Böhringer, C., Rosendahl, K.E.: "Green Promotes the Dirtiest: On the Interaction between Black and Green Quotas in Energy Markets", *Journal of Regulatory Economics* 37 (3), 2010, 316-325.
- Böhringer, C., Rosendahl, K.E.: "Strategic Partitioning of Emissions Allowances under the EU Emissions Trading Scheme", *Resource and Energy Economics* 31, 2009, 182-197.
- Böhringer, C., Rutherford, T.F.: "Combining bottom-up and top-down", *Energy Economics* 30 (2), 2008, 574-596.
- Böhringer, C., Hoffmann, T., Rutherford, T.F.: "Alternative Strategies for Promoting Renewable Energy in EU Electricity Markets", *Applied Economics Quarterly* 58 Supplement, 2007, 9-26.
- Böhringer, C., Hoffmann, T., Lange, A., Löschel, A., Moslener, U.: "Assessing Emission Allocation in Europe: An Interactive Simulation Approach", *The Energy Journal* 26 (4), 2005, 1-22.
- Böhringer, C., Löschel, A.: "Assessing the Costs of Compliance: The Kyoto Protocol", *European Environment* 12 (1), 2002, 1-16.
- Böhringer, C., Rutherford, T.F., Wiegard, W.: "Computable General Equilibrium Analysis: Opening a Black Box", ZEW discussion paper 03-56 ([www.zew.de](http://www.zew.de)).
- Rutherford, T.F., "Applied General Equilibrium Modelling with MPSGE as a GAMS Subsystem", *Computational Economics* 14, 1999, 1-46.
- Rutherford, T.F.: "Extensions of GAMS for Complementarity and Variational Problems Arising in Applied Economics", *Journal of Economic Dynamics and Control*, 1995, 1299-1324.
- Rutherford, T.F.: "GTAP6inGAMS: The Dataset and Static Model" (<http://www.mpsge.org/gtap6/>).