Essen, Germany

September 26– 30, 2022

ECONOMIC IMPACT ASSESSMENT OF ENERGY AND CLIMATE POLICIES USING GAMS AND MPSGE

Instructors:

Christoph Böhringer
University of Oldenburg, Germany

Volker Clausen
University of Duisburg-Essen, Germany

- ***Description***

Computer-based simulations are widely used in applied economic research to quantify the economic impacts of policy reforms. Simulation analysis provides counterfactual ex-ante comparisons, assessing the business-as-usual situation against outcomes induced by policy interference. Among numerical simulation methods, computable general equilibrium (CGE) models constitute a powerful method to perform economy-wide impact assessment of policy reforms based on microeconomic theory and empirical data. More specifically, CGE models are rooted in general equilibrium theory combining assumptions on the behavior of economic agents with the analysis of equilibrium conditions. A key strength of CGE models is their comprehensive coverage of market interactions through price- and income-responsive supply and demand reactions by economic agents.

The workshop teaches step by step the key elements of CGE analysis ranging from the fundamental logic of structural economic equilibrium conditions via the parameterization with empirical data to the application of larger-scale models. The course will build on publications in peer-reviewed international journals to cover important contemporary energy and climate policy issues including

- support policies such as feed-in tariffs or green quotas (portfolio standards) to electricity from renewable energy sources (RES-E),
- phase-out policies for coal and nuclear power plants,
- hybrid emission regulation in different sectors of the economy such as carbon pricing with rebating schemes and efficiency standards, or
- the incidence of emissions pricing and revenue rebating across households in the context of green tax reforms.

The primary focus of the workshop will be on the detailed presentation and discussion of numerical simulation models that are underlying the quantitative policy analysis in these publications. Participants will thereby get familiar with state-of-the-art CGE modeling approaches.

Mathematically the CGE models are formulated and implemented as “mixed complementarity problems” (MCP). The MCP formulation explicitly incorporates the feature of complementary slackness – i.e., complementarity between economic decision variables and associated economic equilibrium conditions – accommodating the comprehensive analysis of real-world economic issues.

For the computer implementation of economic equilibrium models the course builds on the high-level programming language GAMS (Generalized Algebraic Modeling System) whose notation closely follows standard matrix algebra. The fundamental strength of GAMS lies in the ease with which mathematically-defined models can be formulated and solved. To facilitate the formulation of large-scale CGE models, we will use the Mathematical Programming System for General Equilibrium analysis (MPSGE) – a widespread meta-language for CGE modeling operational under GAMS.

Material and teaching is in English. Registered participants will receive the teaching material prior to the start of the workshop such that they can prepare in advance. Teaching will combine lectures on theoretical underpinnings of policy assessment with numerical model applications based on peer-reviewed publications.

- ***Instructors***

Christoph Böhringer

University of Oldenburg

Dr. Christoph Böhringer is Professor of Economic Policy at the Carl von Ossietzky University in Oldenburg. After his graduation as an industrial engineer from the Technical University of Karlsruhe, he received a doctorate in economics at the University of Stuttgart in 1995, where he became head of the Energy Economics section at the Institute for Energy Economics and the Rational Use of Energy (IER). From 1999 to 2006, he led the department Environmental and Resource Economics, Environmental Management at the Leibniz Centre for European Economic Research (ZEW) in Mannheim. In 2002, he qualified as a professor in economics at the University of Regensburg and in 2004 became professor of economics at the University of Heidelberg. In early 2007, he moved from Heidelberg to Oldenburg, where he holds the chair of Economic Policy. He is a research professor at the Centre for European Economic Research (ZEW, Mannheim), a Research Affiliate at the Centre for Energy Policy and Economics (CEPE, ETH Zürich), and a Research Network Fellow at the Center for Economic Studies (CESifo, München). His research activities focus on the economic impact assessment of regulation, especially in the field of environmental, energy, and climate policy. He is a world-leading expert in applied general equilibrium modeling, a powerful research method to quantify the economy-wide impacts of policy interference. His scientific findings are covered by more than 100 peer-reviewed articles published in internationally renowned journals. He is advising governments and academic think tanks around the world on the design of regulatory policies in energy, climate, and trade.

Dr. Volker Clausen

University of Duisburg-Essen

Dr. Volker Clausen has been 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 modelling with a focus on open economies. His publications have a focus on international topics and appeared in various peer-reviewed journals.

- ***Workshop contents***

Part 1: Economic Equilibrium and Mixed Complementarity

- Mixed Complementarity Problems (MCP)
- Optimization, mixed complementarity, and economic equilibrium

Part 2: GAMS Implementation of Basic CGE Models in MCP

- Preferences and technologies in calibrated share form
- Closed-economy model with intermediate inputs
- Initial tax distortions, public good provision, and equal-yield tax reforms
- Unemployment and household heterogeneity
- Open economy and international trade

Part 3: MPSGE Implementation of CGE Models and Excel Data Interface

- MPSGE syntax
- Converting CGE models from MCP into MPSGE
- Routines for reading in data from Excel and pivoting results in Excel
- Systematic sensitivity analysis

Part 4: Technology Foundation of Top-Down CGE Models and Energy Policy Analysis

- Integration of bottom-up electricity market models into top-down CGE models
- Economic impacts of technology-specific policy initiatives such as renewable portfolio standards, coal and nuclear phase-out, or energy efficiency mandates

Part 5: Impact Assessment of Climate Policies

- Green tax reforms and the double dividend
- The incidence of emissions pricing across heterogeneous households: from short-run input-output analysis to mid- and long run general equilibrium effects
- The excess cost of overlapping regulation in climate policy

Note: An exact schedule as well as coverage of aforementioned topics depend on the previous experience of participants with GAMS, MPSGE and CGE modeling and their research interests. Some parts 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.

- ***Target group***

The workshop is targeted to scientific researchers and policy analysts at universities, research centers, consulting companies and ministries who are interested in the economic impact assessment of policy interventions using numerical state-of-the-art models to investigate the economic impacts of energy and climate policies.

- ***Your benefit***

The workshop provides you with state-of-the-art CGE modeling techniques. Application of these techniques will allow you to gain insights into economic theory with numbers and to undertake comprehensive economic impact assessment of policy reforms based on real data.

- ***Prerequisites***

Participants should be familiar with intermediate microeconomics (Master's level). In the run-up to the workshop, participants should get to know the basics of the programming language GAMS which is used for the numerical implementation of equilibrium models as well as data management. A compact do-it-yourself GAMS tutorial will be sent out to participants in advance.

Participants are required to bring along their own laptop and adapters for German power supply if necessary. The GAMS workshop license (valid for 2 months) as well as extensive course material will be provided on USB flash drives.

- ***Payment***

The fee for participating in the training workshop is 2,500 Euro and includes lectures, course material and lunches. 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 **July 1, 2022**. Preference will be given to applicants who have documented previous experience in general equilibrium modelling with GAMS. To apply for a scholarship in the form of a tuition waiver, send your CV and a research paper via email to the course coordinator Mr. Ioannis Arampatzidis. A decision on the allocation of scholarships will be made until **July 8, 2022,** in order to allow for an early arrangement of flights, visa etc.

- ***Registration***

Please contact the course coordinator if you have any questions:

Mr MSc Ioannis Arampatzidis
University of Duisburg-Essen
Department of Economics
45117 Essen, Germany
Telephone: +49 (0)201-18-32310
Fax: +49 (0)201-183-3974
email: ioannis.arampatzidis@vwl.uni-due.de

The registration deadline is **August 26, 2022**. The maximum number of participants is restricted to 16! **Slots are guaranteed only upon full payment of fees through the course coordinator.** Cancellations will be fully refunded if made prior to **August 26, 2022**. 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. The organizer also reserves the right, in the unlikely case of very limited enrolment, to cancel the workshop. Notification of cancellation will be made on **August 27, 2022**. In this case all course fees will be fully refunded.

- ***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

- ***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. Detailed venue information will be provided after reservation.

- ***How to prepare***

No previous knowledge of GE modeling is assumed. However, participants should be familiar with intermediate microeconomics and get somewhat acquainted **beforehand** with GAMS which is the (rather intuitive) programming language used for computer-based model implementation. To be able to follow during the workshop, we suggest for the purpose of preparation the following introductory readings and a short do-it-yourself GAMS tutorial:

- Böhringer, C., Rutherford, T.F., Wiegard, W. (2003): Computable General Equilibrium Analysis: Opening a Black Box, *ZEW discussion paper 03-56*.
- Rutherford, T.F. (1999): Applied General Equilibrium Modelling with MPSGE as a GAMS Subsystem, Computational Economics 14, 1-46.
- Rosenthal R. E.: A GAMS Tutorial.
- J. R. Markusen teaching materials for a course “Simulation Modeling in Microeconomics”, especially chapters 1-4.

Get familiar with GAMS: Download the GAMS User's Guide.

- Download the Demonstration Version of GAMS. The GAMS 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 and an introduction to GAMS from Jensen (2006).

Workshop literature:

- Böhringer, C., Wiegard, W., Starkweather C., Ruocco, A. (2003): Green Tax Reforms and Computational Economics A Do-it-yourself Approach. *Computational Economics*, 22 (1), 75-109.
- Böhringer, C., Löschel, A. (2006): Promoting Renewable Energy in Europe: A Hybrid Computable General Equilibrium Approach. *The Energy Journal*, 2, 135-150.
- Böhringer, C., Hoffmann, T., de Lara Peñate, C.M. (2006): The Efficiency Costs of Separating Carbon Markets Under the EU Emissions Trading Scheme: A Quantitative Assessment for Germany. *Energy Economics*, 28 (1), 44-61.
- Böhringer, C., Moslener, U., Koschel, H. (2008): Efficiency Losses from Overlapping Regulation of EU Carbon Emissions. *Journal of Regulatory Economics*, 33 (3), 299-317.
- Böhringer, C., Rutherford, T.F. (2008): Combining Bottom-up and Top-down. *Energy Economics*, 30 (2), 574-596.
- Böhringer, C., Rosendahl, K.E. (2010): Green Promotes the Dirtiest: On the Interaction between Black and Green Quotas in Energy Markets. *Journal of Regulatory Economics*, 37 (3), 316-325.
- Böhringer, C., Keller, A., van der Werf, E. (2013): Are green hopes too rosy? Employment and welfare impacts of renewable energy promotion. *Energy Economics*, 36, 277-285.
- Böhringer, C., Keller, A., Bortolamedi, M., Rahmeier-Seyffarth, A. (2016): Good things do not always come in threes: On the excess cost of overlapping regulation in EU climate policy. *Energy Policy*, 94, 502-508.
- Böhringer, C., Landis, F. Tovar-Reaños, M.A. (2017): Economic Impacts of Renewable Energy Production in Germany. *The Energy Journal*, 38, 189-209.
- Böhringer, C., Garcia-Muros, X., González-Eguino, M. (2019): Greener and Fairer: A Progressive Environmental Tax Reform for Spain. *Economics of Energy & Environmental Policy*, 8 (2), 141-160.
- Böhringer, C., Garcia-Muros, X., González-Eguino, M. (2022): Who bears the burden of greening electricity?. *Energy Economics*, 105.
- Rutherford, T.F. (1999): Applied General Equilibrium Modeling with MPSGE as a GAMS Subsystem: An Overview of the Modeling Framework and Syntax. *Computational Economics*, 14, 1-46.
- Rutherford, T.F. (1995): Extensions of GAMS for complementarity problems arising in applied economics. *Journal of Economic Dynamics and Control,* 19, 1299–1324.