**cgemod**

# Single Country and Global Recursive Dynamic Computable General Equilibrium (CGE) Modelling:

# Online Course

## Course Description

This course is an introduction recursive dynamic (RDYN) single-country or global computable general equilibrium (CGE) modelling using the General Algebraic Modelling System (GAMS) software. The course is designed for individuals who have a well-developed background in economics and single-country or global CGE modelling, who wish to develop the technical skills needed to implement recursive dynamic single-country or global CGE models. The course emphasises the development of the skills required to develop systematic policy experiments and the interpretation of the results from those experiments. The course also develops the participants understanding of the calibration of RDYN CGE models, the behavioural relationships that control the updating of the model parameters, while enhancing GAMS coding skills. The course uses a mix of video presentations (lectures and 'how to' videos), practical computer exercises and policy analyses exercises.

The course is offered as two variants. The first is a single-country course that builds on the 'Single Country CGE modelling course' and uses the STAGE_t model. The second a global course that builds on the 'Global CGE modelling course' and uses the GLOBE_t model.

The materials are organised in 3 modules offered over 4 weeks, with support offered in a fifth week to allow for 'slippage'. The first module uses the simple SMOD model (used in the Practical CGE modelling course) to introduce the basic concepts underpinning RDYN CGE models; it has 7 components, each of which requires an average of (approximately) 3 hours of input from the participants. The second module has 8 components each taking about 3 hours: this module uses the STAGE_t model (used in the Single Country CGE Modelling course), or the GLOBE_t model (used in the Global CGE Modelling course), to facilitate the introduction of more sophisticated behavioural relationships for updating model parameters.

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This module introduces a more flexible directory and file structure. The final module of the course is devoted to a guided research project that requires about 18 hours of input. Thus, participants should allocate some 65 hours over 3 weeks to complete the course. . Each module requires the participants to submit a deliverable; this allows the tutor to monitor progress and understanding.

Participants on this course are required to have well developed CGE and GAMS skills. A minimum requirements is the completion of the 'Single Country Computable General Equilibrium (CGE) Modelling course' (see www.cgemod.org.uk/single_cge.html for details) or the 'Global Computable General Equilibrium (CGE) Modelling course' (see www.cgemod.org.uk/global_cge.html for details) or provide proof of equivalent or greater skills.[1] The methods used in this course require an understanding of Social Accounting Matrices (SAMs), and the relationships between SAMs and CGE models.

The course assumes that the participants have an in-depth knowledge of microeconomic theory, especially general equilibrium theory, and a reasonable understanding of standard techniques of mathematical economics, especially those relating linear homogenous functions. It is assumed that participants have appreciable experience with programming in GAMS and in the use of MS Excel.

The course is delivered via an electronic learning environment – Moodle. Moodle provides an environment that allows the delivery of learning materials in a structured and organised manner, and an asynchronous forum in which participants can engage with other participants and with the course tutor. The course tutor is available, by email and/or the Moodle message system, to answer specific questions and provide help with problems: questions and requests for advice submitted between 0800 and 1600 UTC will be responded to by the end of the next working (Monday to Friday) day, i.e., by 1600 UTC. Each module requires the participants to submit an assignment; this allows the tutor to monitor progress and understanding, and to intervene if participants are not understanding concepts and techniques or having difficulties. Feedback is provided for each assignment.

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[1] We provide a set of exercises for which satisfactory completion is deemed 'proof of equivalent or greater skills'.

This course does NOT use a GUI (Graphical User Interface) to access GAMS. Experience has demonstrated, to our satisfaction, that the use of GUI's by participants on training programmes typically limits the development of the skills needed to be a good CGE modeller or user of CGE models, while encouraging the belief that CGE models are 'black boxes'. Basic GAMS programming skills, and an understanding of economic theory, demonstrates that allegations that CGE models are 'black boxes' are false. The development of GAMS, or GEMPACK, programming skills greatly extends the ability of the user to exploit the power of CGE models, and, at the same time, opens up the potential that participants can, in the future, change behavioural relationships in CGE models.

A time limited licence for GAMS is available courtesy of GAMS Corporation.

## Course Aims and Objectives

<u>Course Aims</u>

To develop the CGE modelling skills of participants (using GAMS) so they

    i)     understand the behavioural relationships used in RDYN CGE models;

    ii)    understand the impact of different behavioural relationships used to update model parameters in RDYN CGE models;

    iii)   understand the calibration of the model parameters in RDYN CGE models;

    iv)   can formulate appropriate RDYN CGE policy experiments; and

    v)    can interpret the results generated by RDYN CGE models.

<u>Course Objectives</u>

On completion of the course the participants will be able:

    i)     formulate and code appropriate policy experiments;

    ii)    identify and understand the strengths and limitations of RDYN CGE models;

    iii)   modify behavioural relationships that control the updating of model parameters;

    iv)   interpret the results from RDYN CGE models; and

    v)    identify, and present, the policy implications of simulations using RDYN CGE models.

## STAGE & GLOBE Models

This course uses the STAGE_t or GLOBE_t CGE model. STAGE_t and GLOBE_t are developments of the open source STAGE_1 and STAGE_2 models (www.cgemod.org.uk/stage.html) and the GLOBE_1 and GLOBE_2 models (www.cgemod.org.uk/globe.html). STAGE_t and GLOBE_t models are state-of-the-art CGE models designed for the analyses of a wide range of real-world policy issues and advanced bases for the further (academic) model development.

     Participants on this course will be given access to versions of the STAGE_3 and GLOBE_3 models. There are no future plans (as of early 2020) to make STAGE_3 or GLOBE_3 open source; the plan is to restrict the distribution of STAGE_3 and GLOBE_3 to participants of the Global (and single country) CGE courses offered by CGEMOD.

## Timetable

Online courses are run in four cycles – Oct/Nov, Nov/Dec, Jan/Feb and March/April – with recruitment for each course limited to c12 participants. This course will be offered in cycles 2, 3 and 4.

The timetables for courses are available at www.cgemod.org.uk/ttable.html

## Course Fees

The course fees and conditions are detailed at www.cgemod.org.uk/fees.html

Discounts are offered for participants from developing countries ('Low-income economies' and 'Lower-middle-income economies' as classified by the World Bank) and students. Additional discounts are offered for participants who take multiple courses offered by CGEMOD.

A limited number of scholarships are available to students from developing countries. Applications for a scholarship must be made at the time of registration; applications must be accompanied by a case for being awarded the scholarship that is not longer than one-side of A4/US letter. Applicants must be registered at a degree awarding institution, correspond from an academic email address and provide confirmation of their status from an academic advisor.

## Registration

Registration is online at www.cgemod.org.uk/regist.html

## Further Information and registration

For further information please contact Professor Karen Thierfelder

Email: karen@cgemod.org.uk

# Recursive Dynamic CGE (Online) Short Course

## Outline

### Module O15: The Basics of a Recursive Dynamic (SMOD) CGE Model

|  | Topic | Tasks | Exercises |
|---|---|---|---|
| O15:1 | Introduction to Recursive Dynamics |  |  |
| O15:2 | RDYN and the 'Residual' | Economics of Total Factor Productivity and the 'Residual' | Estimating TFP and the 'Residual' |
| O15:3 | Time & RDYN | Understand the meaning of 'time' in RDYN models | Coding the time sets |
| O15:4 | The accumulation of capital | Saving rates; Gross & Net Investment; Depreciation | Coding the physical accumulation of capital (quantity of labour supplies exogenous) |
| O15:5 | 'Business as Usual' Scenario | The meaning and interpretation of 'BaU' scenarios; Defining a baseline | Calibrating and running a 'BaU' scenario |
| O15:6 | Closure settings in RDYN 1 | Macroeconomic closure and market clearing conditions | Setting and changing model closure conditions |
| O15:7 | A first RDYN experiment |  | Tariff reform in a RDYN model **Deliverable O15:1** |

**Readings:**

### Module O16s: Recursive Dynamic Single Country (stg_t) CGE Model

| | Topic | Tasks | Exercises |
|---|---|---|---|
| O16:1 | File and directory structure | Nested sub-directories | Using SETGLOBAL; reference files and searching directories |
| O16:2 | Calibration in RDYN models | Calibration of functional forms in CGE models | Coding time period specific parameters |
| O16:3 | Labour growth in RDYN models | Quantity and 'Quality' of labour | Birth and death rates and the growth of labour supplies |
| O16:4 | Education and labour 'quality' | Investing in education; optimal investments in education | Education and quality of labour services **Deliverable O16:1** |
| O16:5 | Savings rates and steady-state | 'Equilibrium' Saving rates; stock changes and RDYN | Endogenous changes in savings rates |
| O16:6 | R&D and capital 'quality' | Investment in R&D and the quality of capital; perpetual inventories | R&D and the changing quality of capital services |
| O16:7 | Closure settings in RDYN 2 | Macroeconomic closure and market clearing conditions | Setting and changing model closure conditions |
| O16:8 | A second RDYN experiment | | Policy shock **Deliverable O16:2** |

**Readings:**

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**Module O16g: Recursive Dynamic Global (glb_t) CGE Model**

|       | Topic | Tasks | Exercises |
|-------|-------|-------|-----------|
| O16:1 | File and directory structure | Nested sub-directories | Using SETGLOBAL; reference files and searching directories |
| O16:2 | Calibration in RDYN models | Calibration of functional forms in CGE models | Coding time period specific parameters |
| O16:3 | Labour growth in RDYN models | Quantity and 'Quality' of labour | Birth and death rates and the growth of labour supplies |
| O16:4 | Education and labour 'quality' | Investing in education; optimal investments in education | Education and quality of labour services<br>**Deliverable O16:1** |
| O16:5 | Savings rates and steady-state | 'Equilibrium' Saving rates; stock changes and RDYN | Endogenous changes in savings rates |
| O16:6 | R&D and capital 'quality' | Investment in R&D and the quality of capital; perpetual inventories | R&D and the changing quality of capital services |
| O16:7 | Closure settings in RDYN 2 | Macroeconomic closure and market clearing conditions | Setting and changing model closure conditions |
| O16:8 | A second RDYN experiment | | Policy shock<br>**Deliverable O16:2** |

**Readings:**

### Module O17: Course Project

The objectives of the project are to develop your ability to (i) set up and implement policy experiments in a RDYN CGE model; and (ii) interpret the results of your policy experiments. There are five elements to the project; model recalibration, experiment programming, policy experiments and interpretation, sensitivity analyses and project report.

This part of the course synthesizes the coding skills you have developed in the previous exercises and helps develop your ability to set up a database for a model. The emphasis is on interpreting results, particularly in the context of the structure of the economy. The policy simulations, closure assumptions and sensitivity analysis conducted are not prescribed. Instead, you must design the simulation to answer a policy question.

The database provided has databases for 10 countries.

You are an economic consultant hired to analyse policy issues that are relevant and current to your chosen country. The final report will be a maximum of 10 pages.

| | Topic | Tasks | Exercises |
|---|---|---|---|
| O17:1 | STAGE_t RDYN **OR** GLOBE_t RDYN project | The project aims are 1. set up and implement policy experiments in the stg_t CGE model; 2. interpret the results of your policy experiments | There are seven elements to the project; 1. choose country and write-up the 'backstory' 2. Setup the model's Excel database 3. model recalibration and testing; 4. experiment programming; 5. policy experiments and interpretation; 6. sensitivity analyses; and project report (**Deliverable O17:3**) |

**Readings:**