

# Global Computable General Equilibrium (CGE)

## Modelling

### Course Description

This course provides an introduction to global computable general equilibrium (CGE) modelling using the General Algebraic Modelling System (GAMS). The course assumes that the participants have completed a pre course training programme that has introduced them to the GAMS software using simple linear programming examples and basic CGE techniques using exercises based a simple closed economy CGE model and the 1\*2\*3 model.

The course has three parts that are designed to provide a structured training environment within which the participants will study in depth the GLOBE model – a comparative static global CGE model – that is calibrated with data from the Global Trade Analysis Project (GTAP). The main emphasis is on developing a level of understanding about the model, data and the formulation of policy experiments so that at the end of the course participants can use the GLOBE model to conduct practical global policy analyses. A secondary objective is to provide the participants with a framework that can be used, subsequently, as the basis for developing their own CGE programming skills in GAMS.

The GLOBE model is a series of single country models linked through trade accounts; the course exploits this feature of the model to simplify the learning process. The first part of the course uses a single country model (SMOD) that is a version of the single country models embedded in GLOBE. The second part of the course concentrates on the GLOBE model: covering calibration and customization of the model, the formulation of policy experiments and the interpretation of results. The final part of the course is given over to group projects that involve the replication and extension of prior studies carried out with variants of the GLOBE model. The group projects will be based on the following variants: GLOBE for ‘standard’ trade scenarios and GLOBE\_EN for energy and carbon emission scenarios. The allocation of participants to the groups will be based on the instructors’ judgements as to the best distribution of participants across the groups to achieve best overall learning experience for the participants as a whole.

In addition to lectures there is a large amount of computer laboratory time; the course emphasises the development of practical skills and the laboratory sessions provide participants with an environment within which they can develop their programming skills.

Prior to the course participants are provided with a pre course training programme. This is a self-study programme that contains a series of structured exercises; the package of training materials also contains sample solutions for all the exercises. Participants with prior experience of CGE modelling and/or GAMS typically find the supplied materials are adequate for self-study purposes. Participants should begin working on the pre course training materials two months prior to the course and should anticipate spending approximately 40 hours on the exercises.

Hard copies of all the PowerPoint presentations and documentation needed for the course are provided to participants with a binder during the course. At the end of the course participants are provided with a USB memory stick. This contains a limited license version of the GAMS software: this is provided by the GAMS Corporation and provides participants with time to purchase a license from the GAMS Corporation (advice on appropriate minimum specifications is provided), and the following:

- i) the GLOBE model, associated files and exercises used during the course;
- ii) the standard GLOBE model and associated files;
- iii) the GAMS programmes for converting the GTAP database to a SAM structure appropriate for GLOBE and for aggregating the resultant GDX database;
- iv) the model files for ALL the group projects undertaken during the course;
- v) the SeeResults programme for accessing model results;
- vi) the basic SMOD model, data (based on data from the GTAP database) and basic exercises;
- vii) a series of structured exercises that extend the basic SMOD model, e.g., adding nested production structures, multiple trade partners, VAT, etc., together with requisite data (based on data from the GTAP database);

The exercises provided as part of the course emphasise the development of the skills required to formulate policy experiments, interpret results and to develop the (limited) programming skills necessary to implement policy experiments. Considerable private study will be required if graduates of this course wish to develop and extend CGE models, i.e., change and add behavioural relationships. Since a large proportion of applied CGE studies require some

adjustments to the model graduates who wish to conduct CGE modelling on a sustained basis should anticipate devoting time to developing the requisite skills.

### *Course Aims*

To provide an introduction the GLOBE CGE model so that participants can

- i) Appreciate the structure of global CGE models;
- ii) appreciate the contexts within which the application of CGE policy analysis techniques are appropriate;
- iii) implement policy experiments using the GLOBE model; and
- iv) interpret the results from global CGE models.

### *Course Objectives*

On completion of the course the participants will have:

- i) the ability to identify multi regional policy issues that can be appropriately evaluated using CGE techniques;
- ii) the skills to implement policy experiments in the GLOBE CGE model; and
- iii) the ability to interpret the results from global CGE models.

# Outline

## Day 1: Saturday

1130-1230 Registration

Lobby Annapolis Marriott Waterfront

1320 Depart Annapolis Marriott Waterfront Hotel

1400 Welcome and Introductions (Lect)

1415 Course Structure and Content (Lect)

Overview of the course

1430 1. Introduction to Social Accounting Matrices (Lect)

Introduction to Social Accounting Matrices (SAM).

1515 2. A SAM Approach to Modelling (Lect)

The SAM approach to modelling; introduction to macroeconomic closure conditions

1545 Afternoon Break

1615 3. Introduction to the Single Country CGE Model (SMOD) (Lect)

Model data; model structure

1715 Lab 1: Introduction to GAMS, GAMSIDE, GDX and GDXViewer

Configuring GAMS and GAMSIDE; using GDX and GDXViewer

1800 End of the day

1930 Opening reception

English Library, Sampson Hall, USNA

## Day 2: Sunday

0900 4. Prices and Accounting Identities in CGE Models (Lect)

Price definitions, accounting identities and price linkages in a CGE models

1000 5. Tax Instruments & Revenues in SMOD CGE Model (Lect)

The tax system and options in the SMOD Model

- 1025          6. Final Demand (Lect)  
Household utility functions; government and investment demand
- 1045          Morning Break
- 1115          Lab 2: Model Set up and Calibration  
Introduction to the GTAP Based Single Country Model
- 1215          Lab 3: Experiment 1 – trade tax reforms  
Trade Tax Experiments for multiple experiments
- 1300          Lunch Break
- 1400          Lab 4: Experiment 1 – trade tax reforms  
Trade Tax Experiments; using LOOPS to run experiments
- 1500          7. Production Relationships in a Simple CGE Model (Lect)  
Nested production functions; factor use taxes and first order conditions
- 1545          Afternoon Break
- 1615          8. Market Clearing and Macroeconomic Closures in a CGE Model  
Macroeconomic closures
- 1700          Lab 5: Experiment 2 – trade taxes and tax replacement  
Trade Tax Experiments and tax replacement
- 1800          End of the Day

### **Day 3: Monday**

- 0900          Lab 6: Accessing Model Results using SeeResults  
Using SeeResults to access results from CGE models
- 0945          9. Factor Market Clearing in a Simple CGE Model  
Factor market clearing conditions
- 1015          Lab 7: Experiment 3 – trade taxes and factor markets  
Trade Tax Experiments; using LOOPS to run closures and experiments

- 1045      Morning Break
- 1115      Lab 7 (cont): Experiment 3 – trade taxes and factor markets  
Trade Tax Experiments; using LOOPS to run closures and experiments
- 1200      10. Overview of the GLOBE Model (Lect)  
Overview of the structure of the GLOBE model
- 1220      11. Introduction to the GLOBE Database (Lect)  
Introduction to GTAP data in a SAM format
- 1300      Lunch Break
- 1400      12. Trade Relationships in the GLOBE Model (Lect)  
Introduction to the behavioural relationships for trade – imports and exports
- 1430      13. Additional Price Linkages in the GLOBE Model (Lect)  
Price relationships (for trade) in the GLOBE model.
- 1515      Afternoon Break
- 1615      14. Lab 8: Running a Policy Experiment in GLOBE  
Setting up, running and extracting results to SeeResults for a simple trade liberalisation scenario in the 4\*3\*3 GLOBE model
- 1645      Lab 9: Implementing and Interpreting a Trade Policy Experiment  
Interpreting the results for a trade liberalisation scenario in the 4\*3\*3 GLOBE model
- 1800      End of Day
- 1930      Course Dinner  
Café Normandie, Main Street, Annapolis.

## Day 4: Tuesday

- 0900      15. Taxes and Efficiency in the GLOBE Model  
Introduction to the tax rate and efficiency parameter equations.
- 0930      16. Lab 10: Model Set up and Calibration  
Additional options for setting up and calibrating the GLOBE model.

1000      17. Lab 11: Market Clearing and Macroeconomic Closures Rules in GLOBE  
Macroeconomic closure and tax replacement options in GLOBE

1045      Morning Break

1115      17. Lab 11 (cont): Market Clearing and Macroeconomic Closures Rules in GLOBE  
Factor market clearing options in GLOBE

1245      Allocation of participants to Group Projects  
Group 1: GLOBE: DOHA Development Agenda.  
Group 2: GLOBE\_EN: Taxing carbon emissions.  
Group 3: GLOBE\_MIG: Labour migration.

1300      Lunch Break

1400      Afternoon off

## **Day 5: Wednesday**

0900      18. Lab 12: Interpreting Model Results  
Interpreting model results from an implementation of GLOBE.

1030      Morning Break

1100      19. Lab 12 (cont): Interpreting Model Results  
Interpreting model results from an implementation of GLOBE

1210      22. GLOBE\_2  
Changes in GLOBE for version 2.

1220      21. GLOBE\_MIG  
Introduction the GLOBE\_MIG (migration) model.

1240      20. GLOBE\_EN  
Introduction to the GLOBE\_EN (energy) model.

1300      Lunch Break

1400      Lab 12: Replication of Application  
Replication of key simulations in applications.

- 1545          Afternoon Break
- 1615          Lab 13: Extensions to the applications  
Groups develop extensions to the applications
- 1745          23/24. Lab 14: Data support programmers – GTAPinaSAM; SAMGator  
Extracting GTAP data to a SAM format; transforming SAMG(tap) for GLOBE; Aggregating global SAMs.
- 1800          End of the Day

**Day 6: Thursday**

- 0900          Lab 15: Extensions & Analyses of the applications  
Groups complete extensions and begin analyses of the applications
- 1045          Morning Break
- 1115          Lab 15 (cont): Extensions & Analyses of the applications  
Groups complete extensions and begin analyses of the applications
- 1300          Lunch Break
- 1400          Lab 16: Analyses of the applications  
Groups complete analyses of the applications
- 1545          Afternoon Break
- 1615          Lab 16 (cont): Analyses of the applications  
Groups complete analyses of the applications
- 1700          Complete Presentations  
Groups complete PowerPoint presentations..
- 1800          End of the Day
- 1930          Closing Reception  
Annapolis Marriott Waterfront



**Day 7: Friday - Presentations of Applications**

- 0930          Group 1  
                Team presentation
  
- 1015          Morning Break
  
- 1045          Group 2  
                Team presentation
  
- 1130          End of the Course