Dynamic General Equilibrium Model for Climate Resilient Economic Development

Andrej Drygalla, Katja Heinisch and Christoph Schult* | July 2020
Halle Institute for Economic Research

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

IWH Leibniz-Institut für Wirtschaftsforschung Halle

On behalf of:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany

* Research assistance by Yoshiki Wiskamp is greatly acknowledged.

Outline

Outline

1.1 Introduction

- The DGE-CRED model allows its user to analyze and compare different scenarios
  - The model can be used without a detailed knowledge about programming
  - The user has to edit an excel sheet in order to: (i) set the paths of the exogenous variables, (ii) specify the initial and terminal values, (iii) assign parameter values, etc.
- The following slides encompass a guideline on how to create and simulate a new scenario
  - For a comprehensive explanation on how to set the structural parameters for the simulation, see the presentation "DGE_CRED_Training"

1.2 Setting up a new Sceanrio (1)

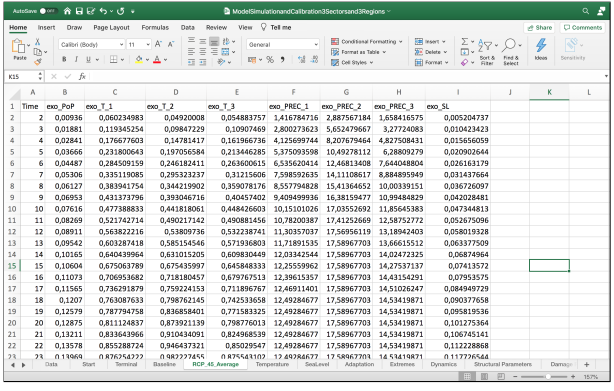
- At first, the user has to choose the:
  - number of sectors k
  - number of regions r
- The settings for the simulation of k sectors and r regions must be provided in "`ModelSimulationandCalibrationkSectorsandrRegions.xlsx`"
- To create a new scenario, a new sheet has to be added to this workbook
  - The name of the sheet becomes the name of the scenario
  - Avoid using symbols or spaces when naming the scenario
  - Examples of valid scenario names: `RCP_45_Average`, `Baseline`

1.2 Setting up a new Sceanrio (2)

- The trajectories of the exogenous variables examined in this new scenario must be added to the excel sheet
  - As the initial value is provided in the sheet "`start`", values starting from period t = 2 must be provided
  - Note that absolute changes compared to the initial value must be provided
  - If no specific trajectory for an exogenous variable is provided in this sheet, the variable will remain at its initial value
  - Include a timeline in the first column of the sheet
  - Recommendation: Include a trajectory for population (`exo_PoP`)

1.2 Setting up a new Sceanrio (3)

- Example: Set up a new scenario called “RCP_45_Average” in a 3 sector and 3 regions setting. Include the trajectories of population (`exo_PoP`), temperature (`exo_T_r`), precipitation (`exo_PREC_r`) and sea level (`exo_SL`).



1.3 DGE_CRED_Model.mod

- After creating a new scenario in "ModelSimulationandCalibrationkSectorsandrRegions.xlsx", open the Dynare file "DGE_CRED_Model.mod"
- Define the number of sectors k and regions r
- Example:

```
% ============================================
% === Define number of sectors and regions ===
% ============================================
@# define Sectors = 3
@# define Regions = 3
```

1.4 RunSimulations.m

- The next step is to open the MATLAB file "RunSimulations.m" and to specify the scenario names in "casScenarioNames"
- Example:

```
% ========================================
% === Script to do multiple Simulations ===
% ========================================
% add dynare path to the search path of matlab
addpath('C:\dynare\4.6.1\matlab')
% specify scenario names
casScenarioNames = {'Baseline','RCP_45_Average'};
% execute dynare to run the model
dynare DGE_CRED_Model noclearall
```

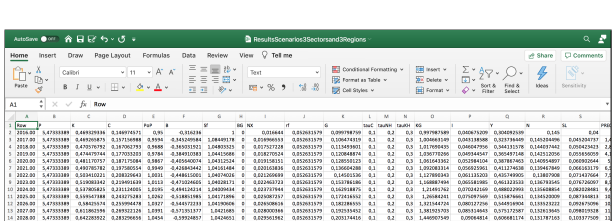
- Now, everything is set up for the simulation of the new scenario
  - Press "Run" to conduct the simulation

1.5 ResultsScenarioskSectorsandrRegions.xlsx (1)

- The results of the simulation are stored in "ResultsScenarioskSectorsandrRegions.xlsx"
- There will be a result sheet for every scenario containing the trajectories of all model variables

1.5 ResultsScenarioskSectorsandrRegions.xlsx (2)

- Example:



Outline

2. Appendix
   - Determine the Trajectories of the Climate Variables
   - Generate a Climate Change Scenario Sheet Automatically

2.1 Determine the Trajectories of the Climate Variables (1)

- The set of MATLAB files starting with the abbreviation `CCS` (Climate Change Scenarios) can be used to generate trajectories for temperature (`T`), precipitation (`PREC`) and sea level (`SL`)
- The excel workbook "`Input_Climate_Change_Scenarios.xlsx`" has to be edited by the user
  - The regions have to be specified in the sheet "`define regions`"
  - The target values for the climate variables must be provided in the respective sheets

2.1 Determine the Trajectories of the Climate Variables (2)

- Next, the user has to choose among different options/procedures in the MATLAB file "`CCS_Run.m`"
  - Now, everything is set up and the code can be executed
- The set of `CCS` files generates a discrete trajectory (annual basis) for all climate variables and scenarios specified in "`Input_Climate_Change_Scenarios.xlsx`"

2.2 Generate a Climate Change Scenario Sheet Automatically (1)

- A scenario sheet can be generated and directly written into "ModelSimulationandCalibrationkSectorsandrRegions.xlsx" by using the MATLAB code "CCS_write_to_ModelSimulationandCalibrationkSectorsandrRegions.m"
  - Advantage: New scenarios for the climate variables do not have to be assembled manually
- This code can be use:
  - After the the MATLAB code "CCS_Run.m" has been executed
  - While these results are still in the MATLAB memory

2.2 Generate a Climate Change Scenario Sheet Automatically (2)

- The number of sectors k as well as the desired combination of the climate variables has to be chosen by the user
- Example:

```
% Choose the number of sectors:
number_of_sectors = 3;

% Design your scenario:
simulation_scenario_RCP = {'4.5'};
simulation_scenario_T = {'yes'};
simulation_scenario_type = {'Average'};
simulation_scenario_PREC = {'yes'};
simulation_scenario_PREC_type = {'Average'};
simulation_scenario_SL = {'yes'};
simulation_scenario_SL_type = {'Average'};
```

- A descriptive name for the sceanrio will be assigned automatically