

DGE–CRED Practical Session 3: Implementation of damages on the agriculture sector

Andrej Drygalla, Katja Heinisch and Christoph Schult* | October 2022
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

Task 1: Calibration workbook and the Baseline scenario.

- Use the CreateRawExcelInputFileRobust.m in the function folder.
- Sectors are: Rice, Agriculture, forestry and fishing; Industry; Services
- Subsectors are: Rice; Agriculture, forestry and fishing excluding rice; Industry; Services
- Region: Vietnam without MRD; MRD
- Climate variables regional: surface temperature (tas)
- Climate variables national: sea level (SL)
- Use the Calibration.xlsx file and copy the Sheet Data and the Baseline sheet into the ModelSimulationandCalibration4Sectorsand2Region.xlsx.
- Run the Baseline scenario.

Task 1: Calibration workbook and the Baseline scenario.

- First modify line 12 to 15 in the CreateRawExcelInputFileRobust.m

<pre>% CreateRawExcelInputFileRobust is a Matlab script to create the % ModelSimulationandCalibration<Number of Subsectors>Sectorsand<Number of % Regions>Regions.xlsx workbook for parameter and scenario definitions of the % model.</pre>	
<pre>%% Prologue clearvars; % define working directory path sPathWD = pwd();</pre>	
<pre>%% Define sectors casSectors = {'Rice', 'Agriculture, forestry, fishery excluding rice'; 'Industry'; 'Services'}; inbsectors_p = length(casSectors);</pre>	
<pre>%% Define subsectors casSubSectors = {'Rice'; 'Agriculture, forestry, fishery excluding rice'; 'Industry'; 'Services'}; inbsubsectors_p = length(casSubSectors);</pre>	
<pre>%% Define regions casRegions = {'Vietnam without MRD'; 'MRD'}; inbregions_p = length(casRegions);</pre>	
<pre>%% Define regional climate variables casClimateVarsRegionalName = {'surface temperature (Celsius)'}; casClimateVarsRegional = {'tas'};</pre>	
<pre>%% Define national climate variables casClimateVarsNationalName = {'Sea level'}; casClimateVarsNational = {'SL'}; casClimateVars = [casClimateVarsRegional casClimateVarsNational];</pre>	
<pre>%% Create the workbook sWorkBookName = ['ModelSimulationandCalibration' num2str(inbsubsectors_p) 'Sectorsand' num2str(inbregions_p) 'Regions.xlsx'];</pre>	

Task 1: Calibration workbook and the Baseline scenario I.

- Copy from Calibration.xlsx file the data into the ModelSimulationandCalibration3Sectorsand1Region.xlsx Sheet Data.

Sector	Region	Initial Value Added Shares (ϕ_iY_0)	Initial Employment Shares (ϕ_iN_0)	Labour Cost Shares (ϕ_iW)
Rice	Vietnam without MRD	0.015307	0.044244	0.494986
Rice	MRD	0.019587	0.056615	0.494986
Agriculture, forestry, fishery excluding rice	Vietnam without MRD	0.09012	0.260483	0.499491
Agriculture, forestry, fishery excluding rice	MRD	0.035092	0.10143	0.499491
Industry	Vietnam without MRD	0.339898	0.121816	0.499491
Industry	MRD	0.079301	0.028258	0.499491
Services	Vietnam without MRD	0.34907	0.315529	0.602307253
Services	MRD	0.071625	0.071625	0.602307253

Task 1: Calibration workbook and the Baseline scenario II.

- Copy from Calibration.xlsx file the data into the ModelSimulationandCalibration3Sectorsand1Region.xlsx Sheet Data.

Sector	export share (phiX)	import share (phiM)	intermediate products (phiQI)
Rice	0.35	0.001771	0.559228
Agriculture, forestry, fishery excluding rice	0.166895	0.088229	0.624664
Industry	0.3	0.85	0.75
Services	0.16	0.06	0.66

Task 1: Calibration workbook and the Baseline scenario III.

- Copy from Calibration.xlsx file the data into the ModelSimulationandCalibration3Sectorsand1Region.xlsx Sheet Data.

Name	Value
initial population (PoP0)	0.9171385
initial value added (Y0)	1
import share (phiM)	0.223201935
housing to population ratio (H0)	23.2
investmetns in residential building relative to GDP (sH)	0.005
subsector for adaptation measures in the housing sector (iGAH)	enter value here
subsector for private adaptation measures in the housing sector	enter value here
initial employment (NO_p)	0.150525996

Task 1: Create the Baseline scenario.

- Copy from Calibration.xlsx file the Baseline sheet into the ModelSimulationandCalibration4Sectorsand2Region.xlsx Sheet Data.

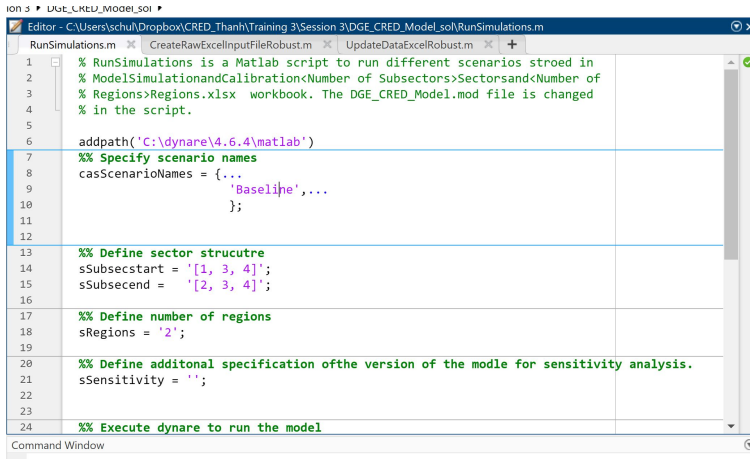
The image shows two Excel spreadsheets side-by-side. The left spreadsheet is titled 'ModelSim...' and the right is 'Calibration.xlsx'. Both have the 'Home' ribbon selected. The left spreadsheet shows cell G3 with the value 1.0703. The right spreadsheet shows cell C2. Both spreadsheets display a table with columns for time, exo_PoP, and various gY and gN values.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Time	exo_PoP	gY_1_1	gY_1_2	gY_2_1	gY_2_2	gY_3_1	gY_3_2	gY_4_1	gY_4_2	gN_1_1	gN_1_2	gN_2_1	gN_2_2
2	2	0	1.028	1.028	1.028	1.028	1.074	1.074	1.083	1.083	0.948	0.948	0.948	1.0
3	3	0	1.027	1.027	1.027	1.027	1.07	1.07	1.079	1.079	0.9506	0.9506	0.9506	1.0
4	4	0	1.025	1.025	1.025	1.025	1.067	1.067	1.075	1.075	0.9531	0.9531	0.9531	1.0
5	5	0	1.024	1.024	1.024	1.024	1.063	1.063	1.071	1.071	0.9554	0.9554	0.9554	1.0
6	6	0	1.023	1.023	1.023	1.023	1.06	1.06	1.068	1.068	0.9576	0.9576	0.9576	1.0
7	7	0	1.022	1.022	1.022	1.022	1.057	1.057	1.064	1.064	0.9598	0.9598	0.9598	1.0
8	8	0	1.021	1.021	1.021	1.021	1.054	1.054	1.061	1.061	0.9618	0.9618	0.9618	1.0
9	9	0	1.02	1.02	1.02	1.02	1.052	1.052	1.058	1.058	0.9637	0.9637	0.9637	1.0
10	10	0	1.019	1.019	1.019	1.019	1.049	1.049	1.055	1.055	0.9655	0.9655	0.9655	1.0
11	11	0	1.018	1.018	1.018	1.018	1.047	1.047	1.052	1.052	0.9672	0.9672	0.9672	1.0
12	12	0	1.017	1.017	1.017	1.017	1.044	1.044	1.05	1.05	0.9689	0.9689	0.9689	1.0
13	13	0	1.016	1.016	1.016	1.016	1.042	1.042	1.047	1.047	0.9704	0.9704	0.9704	1.0
14	14	0	1.015	1.015	1.015	1.015	1.04	1.04	1.045	1.045	0.9719	0.9719	0.9719	1.0
15	15	0	1.014	1.014	1.014	1.014	1.038	1.038	1.043	1.043	0.9733	0.9733	0.9733	1.0
16	16	0	1.014	1.014	1.014	1.014	1.036	1.036	1.04	1.04	0.9746	0.9746	0.9746	1.0

	J	K
80	1.00152	0.99905
81	1.00144	0.9991
82	1.00137	0.99914
83	1.0013	0.99918
84	1.00124	0.99922
85	1.00118	0.99926
86	1.00112	0.9993
87	1.00106	0.99934
88	1.00101	0.99937
89	1.00096	0.9994
90	1.00091	0.99943
91	1.00086	0.99946
92	1.00082	0.99949
93	1.00078	0.99951

Task 1: Execute RunSimulation.m.

- Modify the RunSimulation.m such that the number of regions is 2 and the sector structure is the following: sSubsecstart = '[1, 3, 4]', sSubsecend = '[2, 3, 4]'



```
1 % RunSimulations is a Matlab script to run different scenarios stored in
2 % ModelSimulationandCalibration<Number of Subsectors>Sectorsand<Number of
3 % Regions>Regions.xlsx workbook. The DGE_CRED_Model.mod file is changed
4 % in the script.
5
6 addpath('C:\dynare\4.6.4\matlab')
7 %% Specify scenario names
8 casScenarioNames = {...
9     'Baselihe',...
10    };
11
12
13 %% Define sector structure
14 sSubsecstart = '[1, 3, 4]';
15 sSubsecend = '[2, 3, 4]';
16
17 %% Define number of regions
18 sRegions = '2';
19
20 %% Define additional specification of the version of the model for sensitivity analysis.
21 sSensitivity = '';
22
23
24 %% Execute dynare to run the model
```


Task 2: Create SSP 119, 245 and 585 scenarios.

- Use the ClimateScenariosSSPRegions2MRI.xlsx in the data folder.
- Create a sheet for SSP119, SSP245 and SSP585.
- Copy the climate data for temperature and sea level into the sheet.
- Define damages for rice in the Mekong River Delta and in Vietnam without MRD.
 - ▶ In Vietnam, without the Mekong River Delta, the effect of a 1°C increase in temperature reduces crop yields (exo_D_1_1) by 3 percent.
 - ▶ For the Mekong River Delta, please use the paths provided in the ClimateScenariosSSPRegions2MRI.xlsx file.

Task 2: Copy the climate variables and delete rows not used.

- Make sure that the last values are not zero. Otherwise, they are zero in a steady state.

	A	B	C	D	E				H
75	75	0	1.299887	1.200261	0				0
76	76	0	0.860186	0.869428	0				0
77	77	0	0.925537	0.964379	0				0
78	78	0	1.208053	0.51377	0				0
79	79	0	1.069744	1.367711	0		0	0	0
80	80	0	1.13923	0.896578	0		0	0	0
81	81	0	1.205743	0.90404	0		0	0	0
82	82	0	1.034743	1.060806	0		0	0	0
83	83	0	1.374704	0.891402	0		0	0	0
84	84	0	0.946248	0.580252	0		0	0	0
85	85	0	0.270592	0.333299	0		0	0	0
86	86	0	1.620189	1.068369	0		0	0	0
87	87	0	1.22294	1.049376	0		0	0	0
88	88	0	0	0	0		0	0	0
89	89	0	0	0	0		0	0	0
90	90	0	0	0	0		0	0	0

Task 2: Copy damages to rice located in MRD.

- Use the crop yield simulation results to define damages for different SSP scenarios.

					V2		X ✓ f _x		=0.03°C2	
	E	F	G		T	U	V	W	X	
	exo D 1 2				exo_IAP_4_1	exo_IAP_4_2	exo_D_1_1	exo_D_1_2	exo_D_2_1	exo
1.00826	0				0	0	0	0	0	
1.21	0				0	0	0.0249193	0	0	
1.556	0.143572006				0	0	0.0075176	0.143572	0	
1.902	0.239442052				0	0	0.0202895	0.2394421	0	
2.248	0.248846874				0	0	0.0079096	0.2488469	0	
2.594	0.235920575				0	0	0.0126853	0.2359206	0	
2.94	0.27065458				0	0	0.024799	0.2706546	0	
3.286	0.263283409				0	0	0.0161988	0.2632834	0	
3.632	0.255215317				0	0	0.0234678	0.2552153	0	
3.978	0.277127128				0	0	0.0254819	0.2771271	0	
4.324	0.209105013				0	0	0.0480982	0.209105	0	
4.67	0.223094767				0	0	0.0215483	0.2230948	0	
5.118	0.255333157				0	0	0.0259447	0.2553332	0	
5.566	0.251902049				0	0	0.0317413	0.251902	0	
6.014	0.296199201				0	0	0.0218011	0.2961992	0	
6.462	0.227584993				0	0	0.039471	0.227585	0	
6.91	0.321790091				0	0	0.0406342	0.3217901	0	
7.358	0.2964638				0	0	0.0616203	0.2964638	0	
7.806	0.298819885				0	0	0.0327711	0.2988199	0	
8.254	0.254797453				0	0	0.0316552	0.2547975	0	
					0	0	0.045366	0.2944938	0	
					0	0	0.0333545	0.2814243	0	
					0	0	0.0596263	0.2446234	0	
					0	0	0.0451184	0.2150476	0	
					0	0	0.0719114	0.3049931	0	
					0	0	0.049	0.3639264	0	
					0	0	0.0565294	0.2893073	0	
					0	0	0.0672496	0.2421958	0	
					0	0	0.0378966	0.3531364	0	

Task 2: Define damages to rice not located in MRD.

- The effect of a 1°C increase in temperature reduces crop yields (exo_D_1_1) by 3 percent outside of the Mekong River Delta.

fx =0.03*C2

T	U	V	W	X	Y
exo_IAP_4_1	exo_IAP_4_2	exo_D_1_1	exo_D_1_2	exo_D_2_1	exo_D_2_2
0	0	0	0	0	
0	0	0.0249193	0	0	
0	0	0.0075176	0.143572	0	
0	0	0.0202895	0.2394421	0	
0	0	0.0079096	0.2488469	0	
0	0	0.0126853	0.2359206	0	
0	0	0.024799	0.2706546	0	
0	0	0.0161988	0.2632834	0	
0	0	0.0234678	0.2552153	0	
0	0	0.0254819	0.2771271	0	
0	0	0.0480982	0.209105	0	

Task 2: Execute RunSimulation.m file.

- Change the scenario names to SSP119, SSP245 and SSP585.

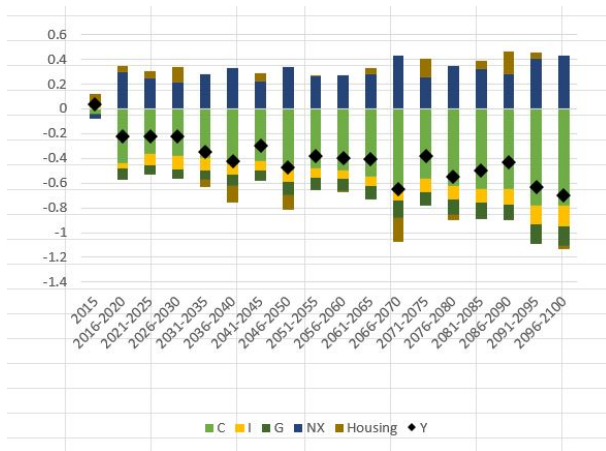
```
Editor - C:\Users\schuh\Dropbox\CRED_Thanh\Training 3\IDGE_CRED_Model_sol\RunSimulations.m
RunSimulations.m  CreateRawExcelInputFileRobust.m  UpdateDataExcelRobust.m  +
1  % RunSimulations is a Matlab script to run different scenarios stroed in
2  % ModelSimulationandCalibration<Number of Subsectors>Sectorsand<Number of
3  % Regions>Regions.xlsx workbook. The DGE_CRED_Model.mod file is changed
4  % in the script.
5
6  addpath('C:\dynare\5.2\matlab')
7  %% Specify scenario names
8  casScenarioNames = {...
9      'SSP119', 'SSP245', 'SSP585',...
10     };
11
12
13  %% Define sector strucutre
14  sSubsectstart = '[1, 3, 4]';
15  sSubsectend = '[2, 3, 4]';
16
17  %% Define number of regions
18  sRegions = '2';
19
20  %% Define additional specification of the version of the modle for sensitivity analysis.
21  sSensitivity = '';
22
23
24  %% Execute dynare to run the model
25  addpath([pwd() '/Functions'])
26  addpath([pwd() '/Functions/Miscellaneous'])
27  addpath([pwd() '/Functions/Auxiliary'])
28  if isoctave()
29      error('Octave is currently not supported please use Matlab 2019 or above')
30  end
31
32  timestart = tic;
33  for icoScenario = 1:size(casScenarioNames,2)
34      sScenario = char(casScenarioNames(icoScenario));
35      % This function allows to switch between endogenous production or
36      % exogenous production
```

Task 3: Create a graph to illustrate the impact of damages to the rice sector on GDP and its components.

- Use the Figures.xlsx file in the Data folder.
- Open the ResultsScenarios4Sectorsand2Regions.xlsx file.
- Change the value in Cell A4 to ResultsScenarios4Sectorsand2Regions.

Task 3: GDP components.

- Damages to the rice sector alone reduce GDP in Vietnam by almost one percent until the end of the century.



Task 4: Create a graph to illustrate the impact of damages to the rice sector on regional value-added, employment, and capital stock.

- Use the Figures.xlsx file in the Data folder.
- Create a graph depicting the deviation between the SSP 585 and Baseline path for Y_1_1, Y_1_2.
- Create a graph depicting the deviation between the SSP 585 and Baseline path for N_1_1, N_1_2.
- Create a graph depicting the deviation between the SSP 585 and Baseline path for K_1_1, K_1_2.
- What do you observe?

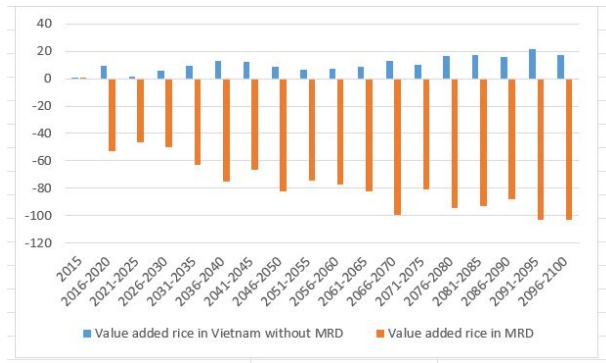
Task 4: Change the links.

- Create a new sheet in Figures.xlsx.
- Change the variables listed in line 2 and compute deviations between the Baseline and SSP scenario.

	A	B	C		D		E		F		G		H		I		J		K		L		M		N	
			Y.1.2	Y.1.2	Y.1.1	Y.1.1	Y.1.1	N.1.2	N.1.2	N.1.2	N.1.1	N.1.1	N.1.1	N.1.1	K.1.2	K.1.2	K.1.1	K.1.1	K.1.1	K.1.1	K.1.1	K.1.1	K.1.1	K.1.1	K.1.1	K.1.1
		Year	Baseline	SSP585	Baseline	SSP585	Baseline	SSP585	Baseline	SSP585	Baseline	SSP585	Baseline	SSP585	Baseline	SSP585	Baseline	SSP585	Baseline	SSP585	Baseline	SSP585	Baseline	SSP585	Baseline	SSP585
1		2014	0.19345	0.1935	0.15117934	0.151179	0.008492	0.006637	0.006637	1.135778	1.135778	0.887598	0.887598	0.887598	0.887598	0.887598	0.887598	0.887598	0.887598	0.887598	0.887598	0.887598	0.887598	0.887598	0.887598	
2		2015	0.230749	0.2308	0.18032815	0.180363	0.008051	0.008055	0.006291	0.006295	1.317867	1.317707	1.029898	1.029744	1.029898	1.029898	1.029898	1.029898	1.029898	1.029898	1.029898	1.029898	1.029898	1.029898	1.029898	
3	Results	2020	0.483801	0.2834	0.37808541	0.415269	0.006405	0.006511	0.005005	0.005792	2.38278	1.850204	1.862116	1.992394	1.850204	1.850204	1.850204	1.850204	1.850204	1.850204	1.850204	1.850204	1.850204	1.850204	1.850204	
4	Scenarios	2025	0.8436	0.5371	0.65926398	0.671852	0.005371	0.005537	0.004198	0.004769	3.740557	2.362955	2.923204	2.952628	2.362955	2.362955	2.362955	2.362955	2.362955	2.362955	2.362955	2.362955	2.362955	2.362955	2.362955	
5	4sectors	2030	1.286052	0.7826	1.0050319	1.067686	0.00469	0.004806	0.003665	0.004214	5.451967	3.319255	4.206352	4.528831	3.319255	3.319255	3.319255	3.319255	3.319255	3.319255	3.319255	3.319255	3.319255	3.319255	3.319255	
6	and	2035	1.774088	0.902	1.38643025	1.518397	0.004224	0.004343	0.003301	0.003978	7.570327	3.85058	5.612618	6.467777	3.85058	3.85058	3.85058	3.85058	3.85058	3.85058	3.85058	3.85058	3.85058	3.85058	3.85058	
7	2regions	2040	2.62986	0.9368	1.77873061	2.014827	0.003896	0.004017	0.003045	0.003871	10.05991	4.144448	7.858583	8.829242	4.144448	4.144448	4.144448	4.144448	4.144448	4.144448	4.144448	4.144448	4.144448	4.144448	4.144448	
8		2045	2.742853	1.3277	1.74305977	2.211106	0.00366	0.003751	0.002861	0.003493	12.76069	6.219578	9.972335	11.357788	6.219578	6.219578	6.219578	6.219578	6.219578	6.219578	6.219578	6.219578	6.219578	6.219578	6.219578	
9		2050	3.172945	1.4154	1.47962143	2.719255	0.003448	0.003663	0.002726	0.003603	15.48569	5.542403	12.1019	13.10399	5.542403	5.542403	5.542403	5.542403	5.542403	5.542403	5.542403	5.542403	5.542403	5.542403	5.542403	
10		2055	3.54986	1.498	1.77417663	2.976768	0.003361	0.003428	0.002626	0.003341	18.05299	7.599073	14.10821	15.21522	7.599073	7.599073	7.599073	7.599073	7.599073	7.599073	7.599073	7.599073	7.599073	7.599073	7.599073	
11		2060	3.87093	1.5346	2.02508090	3.27789	0.003265	0.003354	0.002552	0.0033	20.3464	8.05292	15.90049	17.32331	8.05292	8.05292	8.05292	8.05292	8.05292	8.05292	8.05292	8.05292	8.05292	8.05292	8.05292	
12																										
13																										
			Value Added Rice				Employment Rice				Capital Rice															
			MRD		Vietnam without MRD		MRD		Vietnam without MRD		MRD		Vietnam without MRD		MRD		Vietnam without MRD		MRD		Vietnam without MRD		MRD		Vietnam without MRD	
		2015	0.0207	0.01490346		2015	0.054145	0.053812		2015	-0.0121	-0.01497														
2016-2020			-41.429	7.6856994		2016-2020	1.660155	1.725359		2016-2020	-41.8736	7.025239														
2021-2025			-36.331	1.49214153		2021-2025	3.093812	13.6073		2021-2025	-36.8288	1.005666														
2026-2030			-39.146	4.80157593		2026-2030	2.485022	14.97486		2026-2030	-39.1182	2.94314														
2031-2035			-49.159	7.43854189		2031-2035	2.819498	20.50558		2031-2035	-49.1359	9.324495														
2036-2040			-58.727	10.6154918		2036-2040	3.102915	17.1246		2036-2040	-58.786	12.35158														
2041-2045			-51.595	10.1207033		2041-2045	2.680871	22.12376		2041-2045	-51.2598	13.8929														
2046-2050			-63.901	7.56089792		2046-2050	5.024275	32.18854		2046-2050	-64.2095	8.280446														
2051-2055			-57.802	5.70703139		2051-2055	5.084827	27.21855		2051-2055	-57.9068	7.846517														
2056-2060			-60.356	6.53075877		2056-2060	4.99171	29.30806		2056-2060	-60.4209	8.948312														
2061-2065			-63.906	7.26211679		2061-2065	5.369574	32.55492		2061-2065	-63.9864	9.747892														
2066-2070			-77.454	10.8446666		2066-2070	6.275217	48.59546		2066-2070	-77.7481	10.56934														
2071-2075			-62.952	8.62971315		2071-2075	4.816214	31.5927		2071-2075	-62.7395	13.66897														

Task 4: Impact of climate change on the rice sector in Vietnam I.

- Value-added declines in the Mekong River Delta and increases outside of the Mekong River Delta.



Task 4: Impact of climate change on the rice sector in Vietnam II.

- Employment in the rice sector increases in both regions to compensate for the loss in productivity.



Task 4: Impact of climate change on the rice sector in Vietnam III.

- Capital stock declines in MRD and increases in the rest of Vietnam.



Task 5: Adaptation to climate change in the rice sector (labour tax).

- Assume that the government wants to compensate rice farms in the Mekong River Delta for the loss in crop yields by lowering taxes on labour expenses paid by firms (exo_tauNF_1_2) by 10 percent.
- Create a scenario `SSP585_AdaptTaxLab` and add a column with the name `exo_tauNF_1_2`.
- Reduce the tax rate paid by farmers in the Mekong River Delta by 10 percent.
- Is this adaptation measure effective?

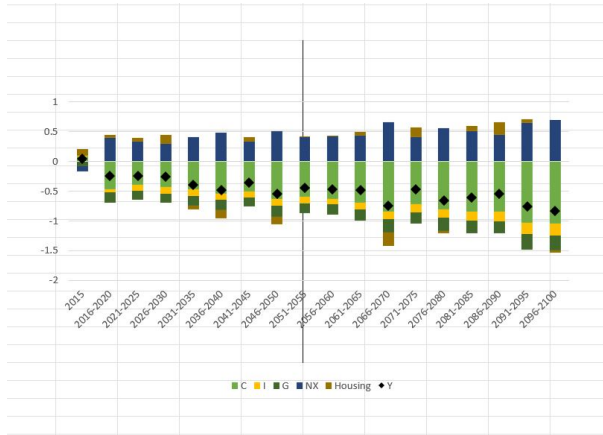
Task 5: Create SSP585_AdaptTaxLab.

- Add a column in the scenario sheet with `exo_tauNF_1_2`.
- Run the scenario by executing the `RunSimulation.m` file.

	E	F	G	H	I
2	exo_SL	exo_tauNF_1_2	exo_GA_1_1	exo_GA_1_2	exo_GA_2_1
0	1.0083	-0.1	0	0	0
1	1.21	-0.1	0	0	0
1	1.556	-0.1	0	0	0
7	1.902	-0.1	0	0	0
4	2.248	-0.1	0	0	0
6	2.594	-0.1	0	0	0
7	2.94	-0.1	0	0	0
5	3.286	-0.1	0	0	0
8	3.632	-0.1	0	0	0
5	3.978	-0.1	0	0	0
6	4.324	-0.1	0	0	0
2	4.67	-0.1	0	0	0
2	5.118	-0.1	0	0	0
9	5.566	-0.1	0	0	0
6	6.014	-0.1	0	0	0

Task 5: Create GDP component figure for SSP585_AdaptTaxLab.

- Copy the GDP sheet in Figures and change the reference from SSP 585 to SSP585_AdaptTaxLab.



Task 5: Create GDP component figure for SSP585_AdaptTaxLab.

- Copy the Impact on Rice sheet in Figures and change the reference from SSP 585 to SSP585_AdaptTaxLab.



Task 6: Adaptation to climate change in the rice sector (capital tax).

- Assume that the government wants to compensate rice farms in the Mekong River Delta for the loss in crop yields by lowering taxes on capital expenses paid by firms (exo_tauKF_1_2) by 10 percent.
- Create a scenario `SSP585_AdaptTaxCap` and add a column with the name `exo_tauKF_1_2`.
- Reduce the tax rate paid by farmers in the Mekong River Delta by 10 percent.
- Is this adaptation measure effective?

Task 6: Create SSP585_AdaptTaxCap.

- See solution for Task 5 and change where necessary to
- Change the column name from `exo_tauNF_1_2` to `exo_tauKF_1_2` in the scenario sheet.

Task 7: Private adaptation to climate change in the rice sector (new crop variant).

- Assume that a new rice variant is more heat resistant and is less exposed to the salinity of the soil.
- Only 5 percent of farmers can switch to the new variant per year.
- The crop yield of the new variant is 50 percent less affected by climate change compared to the old variant.
- Growing the new variant increases running costs by 1 percent of GDP today annually after all farmers switch to the new variant.
- Assume that all farmers eventually switch to the new variant and that the adaptation costs are directly proportional to the share of farmers who have already switched to the new variant.
- Implement the measure in a scenario called SSP585_AdaptPrivate. Use the variable `exo_IAP_1_2` to account for the additional expenditures.
- Is this adaptation measure effective?

Task 7: Create SSP585_AdaptPrivate.

- Change the values for `exo_IAP_1_2` to reflect the necessary time to change from one crop to another.
- The MIN function makes sure that private adaptation expenditures do not exceed 1 percent of current GDP.

=MIN(1;0.05*(\$A2-1))*0.01						
	M	N	O	P	Q	
_1	exo_GA_4_2	exo_IAP_1_1	exo_IAP_1_2	exo_IAP_2_1	exo_IAP_2_2	exo.
0	0	0	0.0005	0	0	
0	0	0	0.001	0	0	
0	0	0	0.0015	0	0	
0	0	0	0.002	0	0	
0	0	0	0.0025	0	0	
0	0	0	0.003	0	0	
0	0	0	0.0035	0	0	
0	0	0	0.004	0	0	

Task 7: Create SSP585_AdaptPrivate.

- The impact of climate change depends on the time farmers have to switch to the new crop.
- Therefore the

SUM		: X ✓ f _x		=(MIN(1;0.05*(A2-1))*0.5 + (1-MIN(1;0.05*(A2-1))))*SSP585!W2				
	V	W	X	Y	Z	AA	AB	
1	exo_D_1_1	exo_D_1_2	exo_D_2_1	exo_D_2_2	exo_D_3_1	exo_D_3_2	exo_D_4_1	exo_D_4_2
2		0.585851W2	0	0	0	0	0	0
3	0.024919	0	0	0	0	0	0	0
4	0.007518	0.132804	0	0	0	0	0	0
5	0.020289	0.215498	0	0	0	0	0	0
6	0.00791	0.217741	0	0	0	0	0	0
7	0.012685	0.200532	0	0	0	0	0	0
8	0.024799	0.22329	0	0	0	0	0	0
9	0.016199	0.210627	0	0	0	0	0	0
10	0.023468	0.197792	0	0	0	0	0	0
11	0.025482	0.207845	0	0	0	0	0	0
12	0.048098	0.151601	0	0	0	0	0	0
13	0.021548	0.155166	0	0	0	0	0	0

Task 8: Public adaptation to climate change in the rice sector (new crop variant).

- Assume the same adaptation measure as in Task 7.
- This time adaptation measures are financed by public government expenditures
exo_GA_1_2
- What differences do you observe compared to Task 7?

Task 8: Public adaptation to climate change in the rice sector (new crop variant).

- Follow the solution for Task 7. instead of changing `exo_IAP_1_2`, change `exo_GA_1_2`.
- We can see the same adaptation measure financed by government or private funds can have slightly different impacts on GDP effects.

Task 9: What adaptation measure is the best to reduce the loss in consumption?

- What adaptation measure can reduce the consumption loss the most?
- Is it ok to compare only the differential in consumption levels?

Task 9: What adaptation measure is the best to reduce the loss in consumption at the end of the century?

- Computing multipliers show that even though private and public adaptation measures have the highest benefit reducing capital or labour tax gets more return relative to the necessary costs.

Capital Tax			
	Consumption benefit	Cost	
2091-2095	0.076608202	0.000353	217.2726
2096-2100	0.076725467	0.000353	217.5668
Labour Tax			
	Consumption benefit	Cost	
2091-2095	0.057267725	0.000346	165.7106
2096-2100	0.057699927	0.000346	166.9317
Private			
	Consumption benefit	Cost	
2091-2095	0.556382731	0.01	55.63827
2096-2100	0.551351544	0.01	55.13515
Public			
	Consumption benefit	Cost	
2091-2095	0.610459639	0.01	61.04596
2096-2100	0.604972381	0.01	60.49724