DGE–CRED Practical Session 2: Implementation of storms, land loss and labour productivity losses

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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.

- Create folder named ExcelFiles
- Use the CreateRawExcelInputFileRobust.m in the function folder to create the excel file.
- Sectors and subsectors are: Agriculture, forestry and fishing; Industry; Services
- Region: Vietnam
- Climate variables regional: surface temperature (tas), storms (storms)
- Climate variables national: sea level (SL)
- Use the Calibration.xlsx file in data folder and copy the Sheet Data and the Baseline sheet into the ModelSimulationandCalibration3Sectorsand1Region.xlsx.
- Update parameters and run the Baseline scenario.

Task 1: Calibration workbook and the Baseline scenario.

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

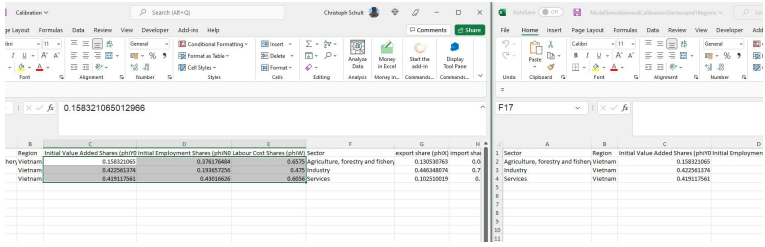
```
%% Define sectors
casSectors = {'Agriculture, forestry and fishery'; 'Industry'; 'Services'};
inbsectors_p = length(casSectors);
%% Define subsectors
casSubSectors = {'Agriculture, forestry and fishery'; 'Industry'; 'Services'};
inbsubsectors_p = length(casSubSectors);
%% Define regions
casRegions = {'Vietnam'};
inbregions_p = length(casRegions);

%% Define regional climate variables
casClimateVarsRegionalName = {'surface temperature (Celsius)', 'storms (storms)'};
casClimateVarsRegional = {'tas', 'storms'};

%% Define national climate variables
casClimateVarsNationalName = {'Sea level'};
casClimateVarsNational = {'SL'};
casClimateVars = [casClimateVarsRegional casClimateVarsNational];
```

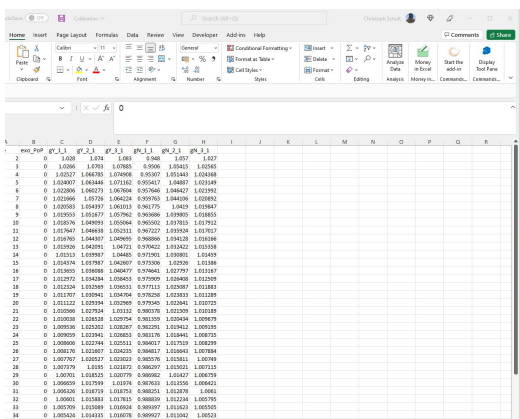
Task 1: Calibration workbook and the Baseline scenario.

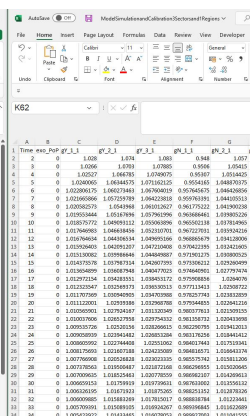
- Copy from Calibration.xlsx file the data into the ModelSimulationandCalibration3Sectorsand1Region.xlsx Sheet Data.



Task 1: Copy the Baseline scenario.

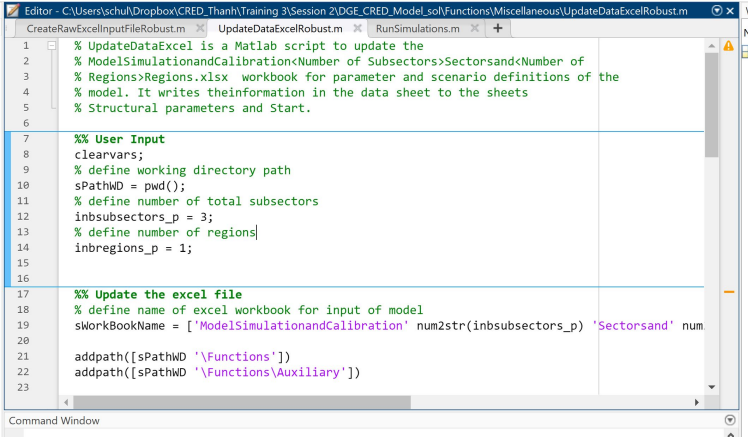
- Copy from Calibration.xlsx file the Baseline scenario into the ModelSimulationandCalibration3Sectorsand1Region.xlsx Baseline sheet.





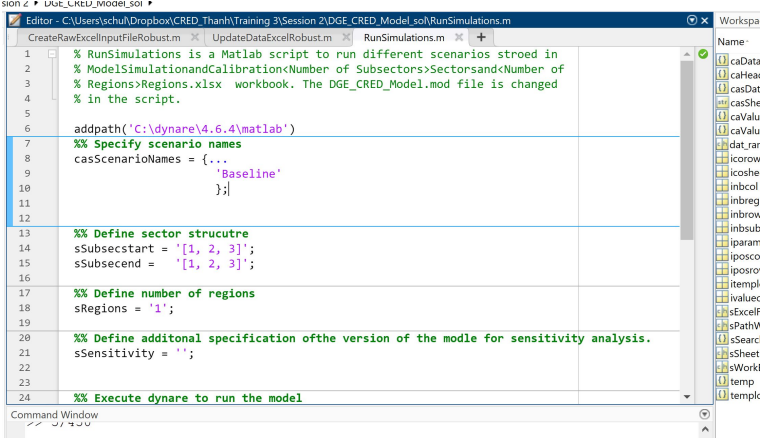
Task 1: Update the parameters.

- Run UpdateDataExcelRobust.m.



Task 1: Run the Baseline scenario.

- Execute RunSimulation.m
- makes sure that you add the right dynare version, have the right scenarios specified and the correct vector for sSubsecstart and sSubsecend.

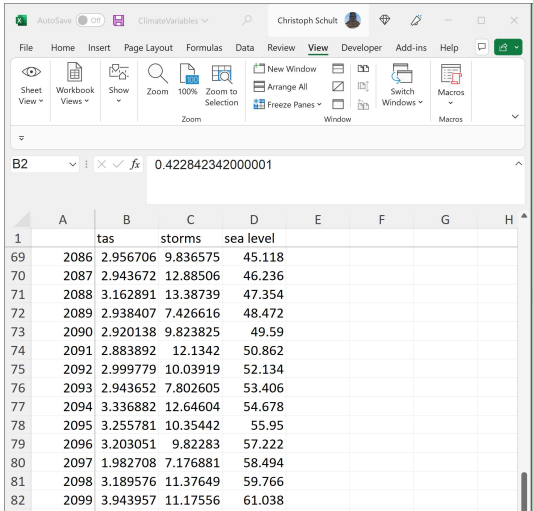


Task 2: Define SSP 119, 245 and 585 scenario.

- Create three scenarios called SSP119, SSP245 and SSP585.
- Use the ClimateVariables.xlsx file.
- Copy temperature, storms and sea level to the respective sheet and place them in column C-E.
- Delete empty rows from row 84 on wards.
- Run the scenarios.

Task 2: Create the SSP 119, 245 and 585 scenario.

- Make sure that the last values for the climate variables are not zero.
- Copy the data from the ClimateVariables.xlsx file into the sheets.



AutoSave Off ClimateVariables Christoph Schult

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Sheet View Workbook Views Show Zoom 100% Zoom to Selection New Window Arrange All Freeze Panes Zoom Window Switch Windows Macros Macros

B2 0.422842342000001

	A	B	C	D	E	F	G	H
1		tas	storms	sea level				
69	2086	2.956706	9.836575	45.118				
70	2087	2.943672	12.88506	46.236				
71	2088	3.162891	13.38739	47.354				
72	2089	2.938407	7.426616	48.472				
73	2090	2.920138	9.823825	49.59				
74	2091	2.883892	12.1342	50.862				
75	2092	2.999779	10.03919	52.134				
76	2093	2.943652	7.802605	53.406				
77	2094	3.336882	12.64604	54.678				
78	2095	3.255781	10.35442	55.95				
79	2096	3.203051	9.82283	57.222				
80	2097	1.982708	7.176881	58.494				
81	2098	3.189576	11.37649	59.766				
82	2099	3.943957	11.17556	61.038				

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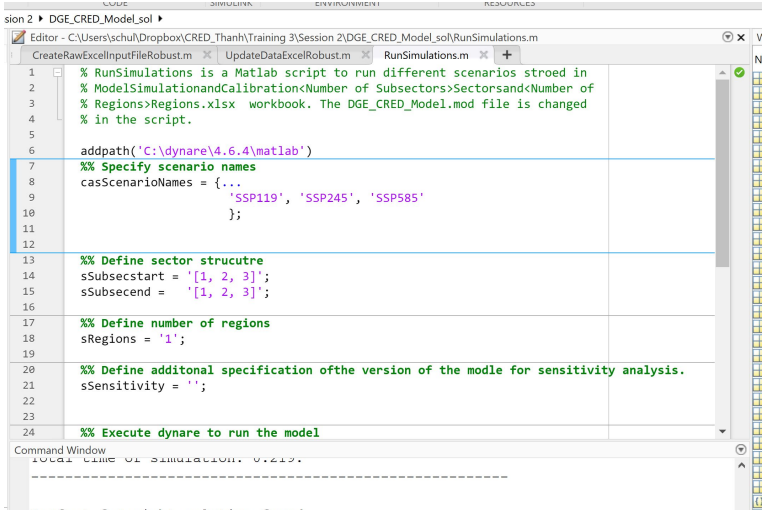
	A	B	C	D	E
1	Time	exo_PoP	exo_tas_1	exo_storms_1	exo_SL e
2	2	0	0.422842	4.656261068	1.008
3	3	0	0.826634	5.944776264	1.21
4	4	0	0.53996	4.77154533	1.556
5	5	0	0.782261	5.836549163	1.902
6	6	0	0.849398	6.639448291	2.248
7	7	0	1.603274	7.268377551	2.594
8	8	0	0.718275	4.868098029	2.94
9	9	0	0.864823	5.472237539	3.286
10	10	0	1.058044	7.708920578	3.632
11	11	0	0.726702	6.403596354	3.978
12	12	0	1.315699	5.2511215	4.324
13	13	0	1.354474	6.984867678	4.67
14	14	0	2.054011	7.368681989	5.118
15	15	0	1.092368	6.70493788	5.566
16	16	0	1.055174	4.646971775	6.014
17	17	0	1.512201	7.637803308	6.462
18	18	0	1.111818	9.478776365	6.91
19	19	0	1.987544	7.528889887	7.358
20	20	0	1.503945	4.983721355	7.806
21	21	0	2.397046	8.310909054	8.254
22	22	0	1.633332	6.079644093	8.702

Task 2: Execute the RunSimulation.m file.

- Rename the casScenarioNames object.
- Each scenario is one character string.



Task 3: Include damages to labour productivity in all scenarios.

Sub-sector	Description	Physical intensity (W)	Productivity reduction ($D_s^{N,Heat}$ in $\frac{\%}{°C}$)
Agriculture, forestry and fishery	Heavy physical work [a]	400	5.71
Industry	Moderate physical work [b]	300	2.38
Services	Clerical/light physical work [c]	200	0.35

Source: Kjellstrom et al. 2019 Table 6.43 and own computation.

[a] exo_D_N_1_1

[b] exo_D_N_2_1

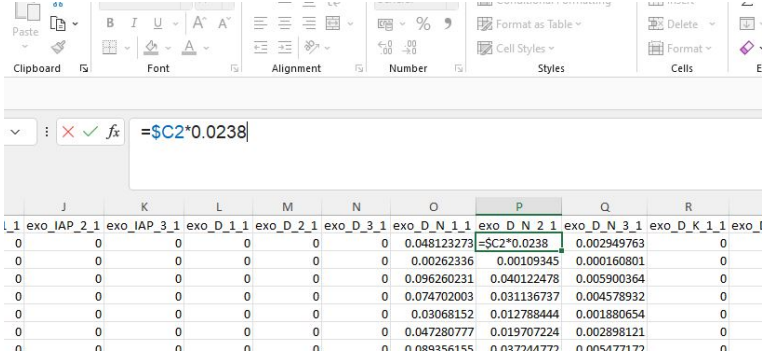
[c] exo_D_N_3_1

Task 3: Agriculture, forestry and fishery

=$C2*0.0571

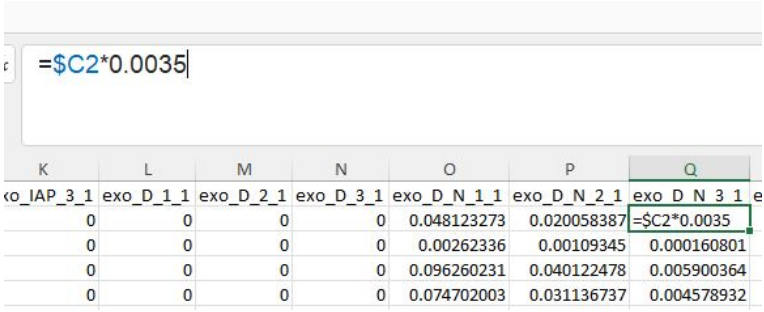
K	L	M	N	O	P
IAP_3_1	exo_D_1_1	exo_D_2_1	exo_D_3_1	exo_D_N_1_1	exo_D_N_
0	0	0	0	=$C2*0.0571	0.020058
0	0	0	0	0.00262336	0.00109
0	0	0	0	0.096260231	0.040122
0	0	0	0	0.074702003	0.031136

Task 3: Industry



J	K	L	M	N	O	P	Q	R	
exo_IAP_2_1	exo_IAP_3_1	exo_D_1_1	exo_D_2_1	exo_D_3_1	exo_D_N_1_1	exo_D_N_2_1	exo_D_N_3_1	exo_D_K_1_1	exo_I
0	0	0	0	0	0.048123273	=$C2*0.0238	0.002949763	0	
0	0	0	0	0	0.00262336	0.00109345	0.000160801	0	
0	0	0	0	0	0.096260231	0.040122478	0.005900364	0	
0	0	0	0	0	0.074702003	0.031136737	0.004578932	0	
0	0	0	0	0	0.03068152	0.012788444	0.001880654	0	
0	0	0	0	0	0.047280777	0.019707224	0.002898121	0	
0	0	0	0	0	0.089356155	0.037244772	0.005477172	0	

Task 3: Services



K	L	M	N	O	P	Q	
xo_IAP_3_1	exo_D_1_1	exo_D_2_1	exo_D_3_1	exo_D_N_1_1	exo_D_N_2_1	exo_D_N_3_1	e
0	0	0	0	0.048123273	0.020058387	=$C2*0.0035	
0	0	0	0	0.00262336	0.00109345	0.000160801	
0	0	0	0	0.096260231	0.040122478	0.005900364	
0	0	0	0	0.074702003	0.031136737	0.004578932	

Task 4: Illustrate the impact of labour productivity on GDP and its components.

- What is the impact on GDP, consumption and investment in the SSP 119, 245 and 585 scenario?
- Use the Figures.xlsx file to create the graph.

Task 4: Rename the workbook you refer to in the Excel sheet.

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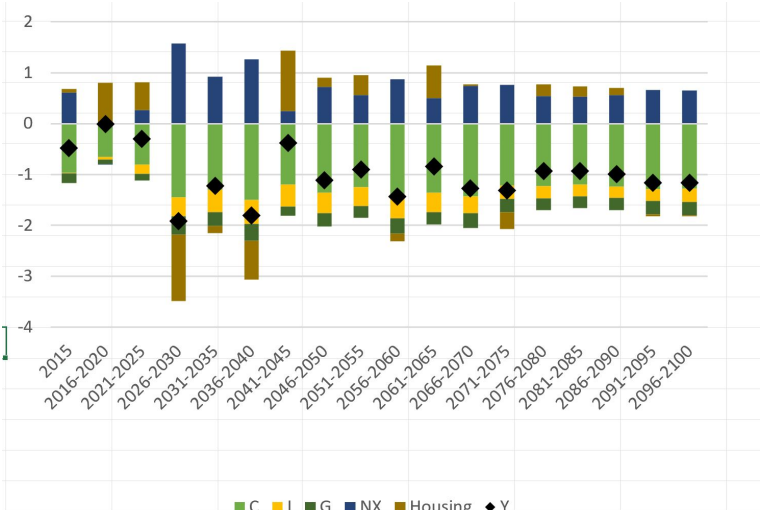
	A	B	C	D	E	F	
1			Y	Y	C	C	I
2		Year	Baseline	SSP119	Baseline	SSP119	B
3		2014	1.165338	1.1653	0.726204	0.726204	
4	ResultsScenarios3Sectorsand1Regions	2015	1.247481	1.239	0.778723	0.768764	
5		2020	1.679994	1.673	1.014928	0.998989	
6		2025	2.126184	2.1204	1.228267	1.205224	
7		2030	2.558817	2.5355	1.440145	1.408944	
8		2035	2.958148	2.9303	1.657551	1.621979	
9		2040	3.3127	3.2675	1.872029	1.825073	
10		2045	3.618043	3.5708	2.071791	2.018991	
11		2050	3.874811	3.8153	2.24923	2.185688	
12		2055	4.086752	4.035	2.401593	2.337262	
13		2060	4.259178	4.1738	2.52936	2.448366	
14		2065	4.397885	4.3432	2.634695	2.557329	
15		2070	4.508495	4.4521	2.720439	2.632806	
16		2075	4.596104	4.4926	2.789545	2.681187	
17		2080	4.66513	4.5616	2.844795	2.729059	
18		2085	4.719294	4.6188	2.888668	2.771214	
19		2090	4.761661	4.6544	2.923301	2.803347	
20		2095	4.794721	4.6797	2.950495	2.82429	

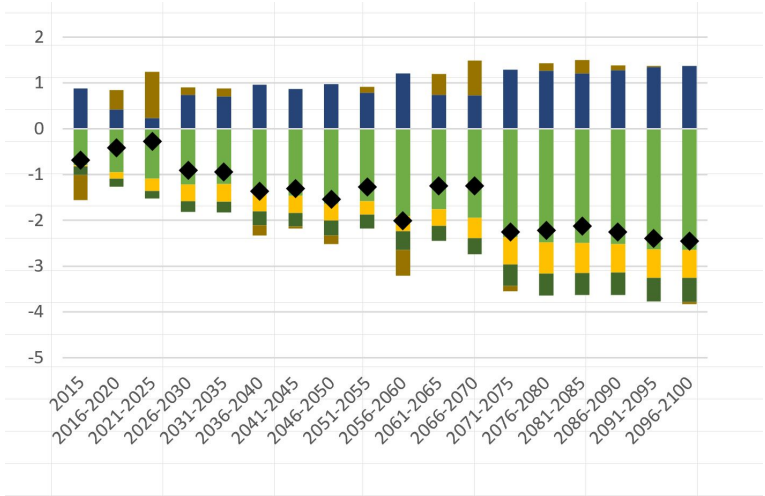
Task 4: SSP 119

- Copy the GDP sheet and rename it into SSP119.
- Make sure to replace all SSP scenarios in line 2 with SSP 119.



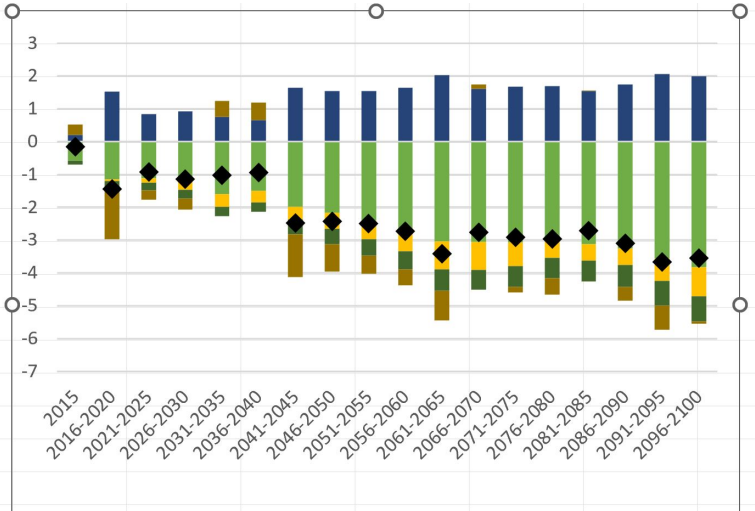
Task 4: SSP 245

- Copy the GDP sheet and rename it into SSP245.
- Make sure to replace all SSP scenarios in line 2 with SSP 245.



Task 4: SSP 585

- Copy the GDP sheet and rename it into SSP585.
- Make sure to replace all SSP scenarios in line 2 with SSP 585.



Task 5: Land loss due to sea level rise in Agriculture, forestry and fishery.

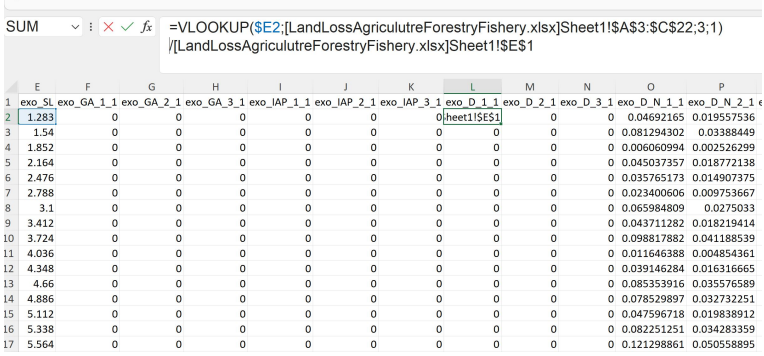
- First, copy the existing SSP scenarios and call them SSP119Lab, SSP245Lab and SSP585Lab.
- Include land loss in agriculture, forestry and fishery such that it reduces total factor productivity (exo_D_1_1) in the sector as a share of total land used in the sector.
- Use the VLOOKUP function to make the land loss conditional on the respective sea level rise.
- You can find the required data in the LandLossAgricultureForestryFishery.xlsx file.

C3 143.445800000001

	A	B	C	D	E
1	Sea level rise (cm)		Vietnam (km^2)	Total land	263939
2	from	to	Land loss (km^2)		
3	0	5	143.4458		
4	5	10	519.03		
5	10	15	617.673		

Task 5: Change damages to total factor productivity in the agriculture, forestry and fishery sector.

- Change the values for exo_D_1_1 in column L for all SSP scenarios.
- Use the VLOOKUP function to refer to the table in LandLossAgricultureForestryFishery.xlsx.



	E	F	G	H	I	J	K	L	M	N	O	P
1	exo_SL	exo_GA_1_1	exo_GA_2_1	exo_GA_3_1	exo_IAP_1_1	exo_IAP_2_1	exo_IAP_3_1	exo_D_1_1	exo_D_2_1	exo_D_3_1	exo_D_N_1_1	exo_D_N_2_1
2	1.283	0	0	0	0	0	0	heet1!$E$1	0	0	0.04692165	0.019557536
3	1.54	0	0	0	0	0	0	0	0	0	0.081294302	0.03388449
4	1.852	0	0	0	0	0	0	0	0	0	0.006060994	0.002526299
5	2.164	0	0	0	0	0	0	0	0	0	0.045037357	0.018772138
6	2.476	0	0	0	0	0	0	0	0	0	0.035765173	0.014907375
7	2.788	0	0	0	0	0	0	0	0	0	0.023400606	0.009753667
8	3.1	0	0	0	0	0	0	0	0	0	0.065984809	0.0275033
9	3.412	0	0	0	0	0	0	0	0	0	0.043711282	0.018219414
10	3.724	0	0	0	0	0	0	0	0	0	0.098817882	0.041188539
11	4.036	0	0	0	0	0	0	0	0	0	0.011646388	0.004854361
12	4.348	0	0	0	0	0	0	0	0	0	0.039146284	0.016316665
13	4.66	0	0	0	0	0	0	0	0	0	0.085353916	0.035576589
14	4.886	0	0	0	0	0	0	0	0	0	0.078529897	0.032732251
15	5.112	0	0	0	0	0	0	0	0	0	0.047596718	0.019838912
16	5.338	0	0	0	0	0	0	0	0	0	0.082251251	0.034283359
17	5.564	0	0	0	0	0	0	0	0	0	0.121298861	0.050558895

Task 6: How important are land losses for the GDP effect?

- Run the SSP scenarios with the land loss effect.
- Create a suitable graph in Figure.xlsx to investigate the additional GDP effect due to land losses.

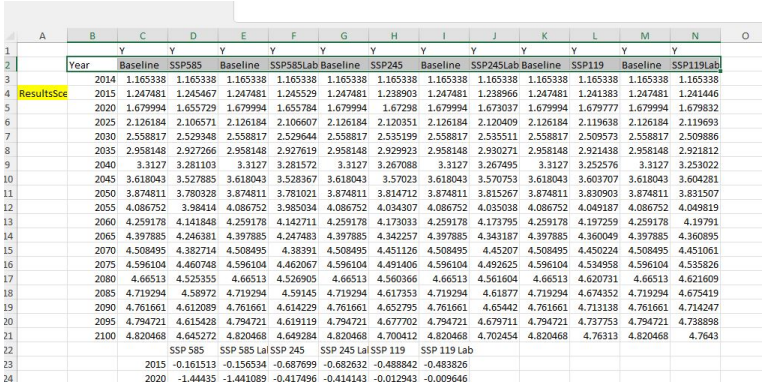
Task 6: Run all scenarios.

- First run all SSP scenarios.

```
% in the script.

addpath('C:\dynare\4.6.4\matlab')
%% Specify scenario names
casScenarioNames = {...
                    'SSP119', 'SSP245', 'SSP585',...
                    'SSP119Lab', 'SSP245Lab', 'SSP585Lab',...
                    };


%% Define sector strucutre
sSubsecstart = '[1, 2, 3]';
sSubsecend =   '[1, 2, 3]';
```

Task 6: Prepare Figures.xlsx file

- Copy the sheet in the Figures.xlsx file and change the references to the SSP scenarios such that you have the following excel workbook:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
2		Year	Baseline	SSP585	Baseline	SSP585Lab	Baseline	SSP245	Baseline	SSP245Lab	Baseline	SSP119	Baseline	SSP119Lab	
3		2014	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	
4	ResultsSce	2015	1.247481	1.245467	1.247481	1.245529	1.247481	1.238903	1.247481	1.238966	1.247481	1.241383	1.247481	1.241446	
5		2020	1.679994	1.655729	1.679994	1.655784	1.679994	1.67298	1.679994	1.673037	1.679994	1.679777	1.679994	1.679832	
6		2025	2.126184	2.106571	2.126184	2.106607	2.126184	2.120351	2.126184	2.120409	2.126184	2.119638	2.126184	2.119693	
7		2030	2.558817	2.529348	2.558817	2.529644	2.558817	2.535199	2.558817	2.535511	2.558817	2.509573	2.558817	2.509886	
8		2035	2.958148	2.927266	2.958148	2.927619	2.958148	2.929923	2.958148	2.930271	2.958148	2.921438	2.958148	2.921812	
9		2040	3.3127	3.281103	3.3127	3.281572	3.3127	3.267088	3.3127	3.267495	3.3127	3.252576	3.3127	3.253022	
10		2045	3.618043	3.527885	3.618043	3.528367	3.618043	3.57023	3.618043	3.570753	3.618043	3.603707	3.618043	3.604281	
11		2050	3.874811	3.780328	3.874811	3.781021	3.874811	3.814712	3.874811	3.815267	3.874811	3.830903	3.874811	3.831507	
12		2055	4.086752	3.98414	4.086752	3.985034	4.086752	4.034307	4.086752	4.035038	4.086752	4.049187	4.086752	4.049819	
13		2060	4.259178	4.141848	4.259178	4.142711	4.259178	4.173033	4.259178	4.173795	4.259178	4.197259	4.259178	4.19791	
14		2065	4.397885	4.246381	4.397885	4.247483	4.397885	4.342257	4.397885	4.343187	4.397885	4.360049	4.397885	4.360895	
15		2070	4.508495	4.382714	4.508495	4.38391	4.508495	4.451126	4.508495	4.45207	4.508495	4.450224	4.508495	4.451061	
16		2075	4.596104	4.460748	4.596104	4.462067	4.596104	4.491406	4.596104	4.492625	4.596104	4.534958	4.596104	4.535826	
17		2080	4.66513	4.525355	4.66513	4.526905	4.66513	4.560366	4.66513	4.561604	4.66513	4.620731	4.66513	4.621609	
18		2085	4.719294	4.58972	4.719294	4.59145	4.719294	4.617353	4.719294	4.61877	4.719294	4.674352	4.719294	4.675419	
19		2090	4.761661	4.612089	4.761661	4.614229	4.761661	4.652795	4.761661	4.65442	4.761661	4.713138	4.761661	4.714247	
20		2095	4.794721	4.615428	4.794721	4.619119	4.794721	4.677702	4.794721	4.679711	4.794721	4.737753	4.794721	4.738898	
21		2100	4.820468	4.645272	4.820468	4.649284	4.820468	4.700412	4.820468	4.702454	4.820468	4.76313	4.820468	4.7643	
22				SSP 585	SSP 585 Lal	SSP 245	SSP 245 Lal	SSP 119	SSP 119 Lab						
23		2015		-0.161513	-0.156534	-0.687699	-0.682632	-0.488842	-0.483826						
24		2020		-1.44435	-1.441089	-0.417496	-0.414143	-0.012943	-0.009646						

Task 6: Prepare Figures.xlsx file

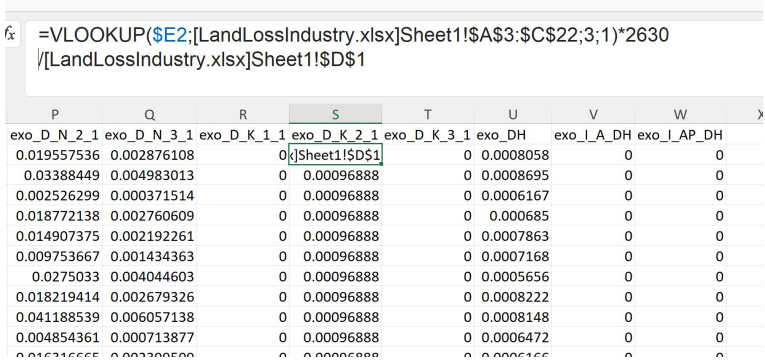
- Depict in bar charts the impact on GDP for the different SSP scenarios.
- We can see that land loss in the agriculture sector has only a small impact.

Task 7: Implement damages to the capital stock of the industry.

- Implement damages to the capital stock in the industry (exo_D_K_2_1) in Vietnam.
- The average value of capital in the manufacturing sector is 2634 $\frac{billionVND}{km^2}$.
- $D_2^K = Landloss\left(\frac{2643}{GDPinbillionVND}\right)$

Task 7: Use VLOOKUP to refer to LandLossIndustry.xlsx file

- First copy the existing SSP scenarios and rename them into SSPxxxLabLLAgri.
- Now, use the same procedure as for Task 5. Instead of the file LandLossAgricultureForestryFishery.xlsx use the LandLossIndustry.xlsx.



=VLOOKUP($E2;[LandLossIndustry.xlsx]Sheet1!$A$3:$C$22;3;1)*2630
/[LandLossIndustry.xlsx]Sheet1!$D$1

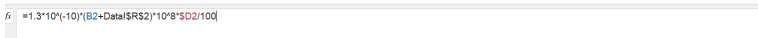
P	Q	R	S	T	U	V	W
exo_D_N_2_1	exo_D_N_3_1	exo_D_K_1_1	exo_D_K_2_1	exo_D_K_3_1	exo_DH	exo_I_A_DH	exo_I_AP_DH
0.019557536	0.002876108	0	k]Sheet1!$D$1	0	0.0008058	0	0
0.03388449	0.004983013	0	0.00096888	0	0.0008695	0	0
0.002526299	0.000371514	0	0.00096888	0	0.0006167	0	0
0.018772138	0.002760609	0	0.00096888	0	0.000685	0	0
0.014907375	0.002192261	0	0.00096888	0	0.0007863	0	0
0.009753667	0.001434363	0	0.00096888	0	0.0007168	0	0
0.0275033	0.004044603	0	0.00096888	0	0.0005656	0	0
0.018219414	0.002679326	0	0.00096888	0	0.0008222	0	0
0.041188539	0.006057138	0	0.00096888	0	0.0008148	0	0
0.004854361	0.000713877	0	0.00096888	0	0.0006472	0	0

Task 8: Implement damages caused by storms to housing.

- Implement damages to housing caused by storms.
- Damages caused per affected person in Vietnam by storms amounted to 890 Thousand VND per affected person.
- relative to GDP in 2018, this amounts to about 1.3×10^{-10} percentage points per year and affected person.
- Damages to houses exo_DH
  $D^H = 10^8 \times \left(\frac{exo\_storms\_1}{100}\right) \times (Pop^{SSP} + Pop_0) \times (1.3 \times 10^{-10})$
- Run all previous scenarios and new scenarios: SSP119LabLLAgri, SSP245LabLLAgri, SSP585LabLLAgri
- Is housing destruction due to storms important for GDP reduction?

Task 8: Destruction of housing stock due to storms

- Here, we need to keep track of the current population development (SUM(B$2:B2) + Data!$R$2)).
- Further, we multiply the current population by the share of affected persons ($D2/100).



D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
exo_storm_1	exo_SL	exo_GA_1_1	exo_GA_2_1	exo_GA_3_1	exo_IAP_1_1	exo_IAP_2_1	exo_IAP_3_1	exo_D_1_1	exo_D_2_1	exo_D_3_1	exo_D_N_1_1	exo_D_N_2_1	exo_D_N_3_1	exo_D_K_1_1	exo_D_K_2_1	exo_D_K_3_1	exo_DH	exo_I_A
6.35612068	1.2833	0	0	0	0	0	0	0.0005435	0	0	0.04692165	0.019557536	0.002876108	0	0.000970354	0	=D2/100	
6.870159302	1.54	0	0	0	0	0	0	0.0005435	0	0	0.081294302	0.03388449	0.004983013	0	0.000970354	0	0.00087	
4.871463535	1.852	0	0	0	0	0	0	0.0005435	0	0	0.006060994	0.002526299	0.000371514	0	0.000970354	0	0.00062	
5.426019287	2.164	0	0	0	0	0	0	0.0005435	0	0	0.045037357	0.018772138	0.002760609	0	0.000970354	0	0.00099	
6.222382262	2.476	0	0	0	0	0	0	0.0005435	0	0	0.035765173	0.014907375	0.002192261	0	0.000970354	0	0.00079	
5.659740052	2.788	0	0	0	0	0	0	0.0005435	0	0	0.023400606	0.009753667	0.001434363	0	0.000970354	0	0.00072	
4.460728169	3.1	0	0	0	0	0	0	0.0005435	0	0	0.065984809	0.0275033	0.004044603	0	0.000970354	0	0.00056	
6.507096593	3.412	0	0	0	0	0	0	0.0005435	0	0	0.043711282	0.018219414	0.002679326	0	0.000970354	0	0.00082	
6.443323909	3.724	0	0	0	0	0	0	0.0005435	0	0	0.098817882	0.041188539	0.006057138	0	0.000970354	0	0.00082	
5.138428455	4.036	0	0	0	0	0	0	0.0005435	0	0	0.011646388	0.004854361	0.000713877	0	0.000970354	0	0.00065	
4.868910304	4.348	0	0	0	0	0	0	0.0005435	0	0	0.039146284	0.016316665	0.002399509	0	0.000970354	0	0.00062	
7.275198682	4.66	0	0	0	0	0	0	0.0005435	0	0	0.085353916	0.035576589	0.005231851	0	0.000970354	0	0.00092	
6.623146337	4.886	0	0	0	0	0	0	0.0005435	0	0	0.078529897	0.032732251	0.004813566	0	0.000970354	0	0.00084	
5.49250233	5.112	0	0	0	0	0	0	0.0019665	0	0	0.047596718	0.019838912	0.002917487	0	0.002306963	0	0.0007	
4.407619851	5.338	0	0	0	0	0	0	0.0019665	0	0	0.082251251	0.034283359	0.00504167	0	0.002306963	0	0.00056	
5.390721635	5.564	0	0	0	0	0	0	0.0019665	0	0	0.121298861	0.050558895	0.007431132	0	0.002306963	0	0.00068	
6.116417154	5.79	0	0	0	0	0	0	0.0019665	0	0	0.071057685	0.029617489	0.004355513	0	0.002306963	0	0.00077	

Task 8: Execute the RunSimulation.m file

- Change the scenarios you want to run with the casScenarioNames.

RawExcelInputFileRobust.m | UpdateDataExcelRobust.m | RunSimulations.m

```
% RunSimulations is a Matlab script to run different scenarios stroed in
% ModelSimulationandCalibration<Number of Subsectors>Sectorsand<Number of
% Regions>Regions.xlsx  workbook. The DGE_CRED_Model.mod file is changed
% in the script.

addpath('C:\dynare\4.6.4\matlab')
%% Specify scenario names
casScenarioNames = {...
                    'SSP119', 'SSP245', 'SSP585',...
                    'SSP119LabLLAgri', 'SSP245LabLLAgri', 'SSP585LabLLAgri',...
                    'SSP119Lab', 'SSP245Lab', 'SSP585Lab',...
                    };


%% Define sector strucutre
sSubsecstart = '[1, 2, 3]';
sSubsecend =   '[1, 2, 3]';

%% Define number of regions
sRegions = '1';

%% Define additonal specification ofthe version of the modle for sensitivity analysis.
sSensitivity = '';
```

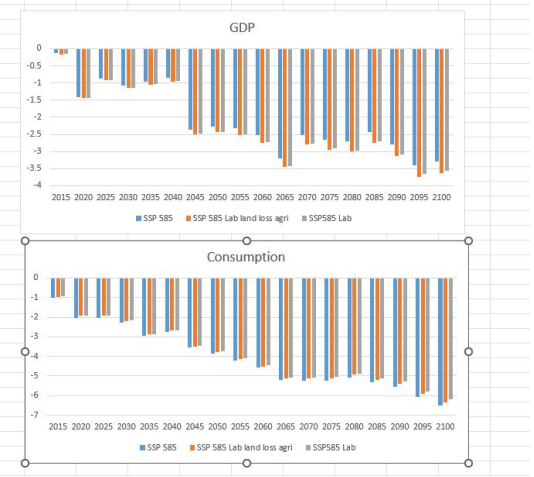
Task 8: Depict the results

- Create a sheet in Figure.xlsx and plot Consumption and GDP relative to the Baseline for the SSP 585 scenario.

	C	C	C		C	C	C	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Year	Baseline	SSP585	Baseline	SSP585Lab	Baseline	SSP585Lab	Baseline	SSP585	Baseline	SSP585Lab	Baseline	SSP585Lab	Baseline	SSP119Lab	Baseline	SSP119Lab	Baseline	SSP119Lab
	2014	0.726204	0.726204		0.726204388	0.726204	0.726204	0.726204	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338	1.165338
ResultsSce	2015	0.778723	0.770956		0.778722685	0.77723	0.778723	0.771196	1.247481	1.245799	1.247481	1.245467	1.247481	1.245529	1.247481	1.241383	1.247481	1.241446
	2020	1.014928	0.994403		1.014928265	0.995407	1.014928	0.995513	1.679994	1.656264	1.679994	1.653729	1.679994	1.655784	1.679994	1.679777	1.679994	1.679832
	2025	1.228287	1.203353		1.228287444	1.204529	1.228267	1.204657	2.126184	2.107729	2.126184	2.106573	2.126184	2.106607	2.126184	2.119638	2.126184	2.119693
	2030	1.440145	1.407215		1.440144705	1.40881	1.440145	1.408587	2.558817	2.515112	2.558817	2.523946	2.558817	2.529944	2.558817	2.509379	2.558817	2.509386
	2035	1.657551	1.608389		1.657551137	1.60971	1.657551	1.610249	2.958148	2.929956	2.958148	2.927266	2.958148	2.927619	2.958148	2.924438	2.958148	2.923812
	2040	1.872029	1.820388		1.872028914	1.821777	1.872029	1.822331	3.3127	3.284886	3.3127	3.281169	3.3127	3.281572	3.3127	3.252576	3.3127	3.253022
	2045	2.071791	1.99841		2.071791273	1.99964	2.071791	2.000292	3.618043	3.532067	3.618043	3.527885	3.618043	3.528367	3.618043	3.603707	3.618043	3.604281
	2050	2.24923	2.162865		2.249230499	2.164331	2.24923	2.165152	3.874811	3.786351	3.874811	3.780328	3.874811	3.781021	3.874811	3.839903	3.874811	3.831507
	2055	2.401193	2.300896		2.40119305	2.302392	2.401193	2.303366	4.086752	3.99214	4.086752	3.985934	4.086752	3.985934	4.086752	4.049187	4.086752	4.049819
	2060	2.52936	2.413676		2.529359817	2.415283	2.52936	2.416371	4.259178	4.151413	4.259178	4.141848	4.259178	4.142711	4.259178	4.197259	4.259178	4.19791
	2065	2.634455	2.497438		2.634459511	2.499638	2.634455	2.500568	4.397883	4.256958	4.397883	4.246381	4.397883	4.247403	4.397883	4.360049	4.397883	4.360855
	2070	2.729439	2.578266		2.729418803	2.581189	2.729439	2.582682	4.508495	4.394307	4.508495	4.382734	4.508495	4.383391	4.508495	4.450224	4.508495	4.451061
	2075	2.789545	2.6435		2.789545148	2.647049	2.789545	2.64873	4.596104	4.473598	4.596104	4.460748	4.596104	4.462067	4.596104	4.534958	4.596104	4.535826
	2080	2.844795	2.709508		2.844794664	2.704448	2.844795	2.706414	4.66513	4.539547	4.66513	4.525355	4.66513	4.526905	4.66513	4.620731	4.66513	4.621609
	2085	2.888668	2.735082		2.888667771	2.739013	2.888668	2.741212	4.715294	4.604913	4.715294	4.58972	4.715294	4.59145	4.715294	4.674352	4.715294	4.675419
	2090	2.923301	2.761445		2.923300818	2.765857	2.923301	2.768637	4.761661	4.669411	4.761661	4.652085	4.761661	4.654225	4.761661	4.713138	4.761661	4.714247
	2095	2.959485	2.77113		2.959485235	2.775893	2.959485	2.779791	4.794721	4.71203	4.794721	4.693428	4.794721	4.696119	4.794721	4.737753	4.794721	4.738898
	2100	2.971758	2.777939		2.971758456	2.783252	2.971758	2.787446	4.820468	4.662326	4.820468	4.645272	4.820468	4.649284	4.820468	4.76313	4.820468	4.7643

Task 8: Consumption vs. GDP effect

- Destruction of the housing stock leads to lower consumption but not to lower GDP.

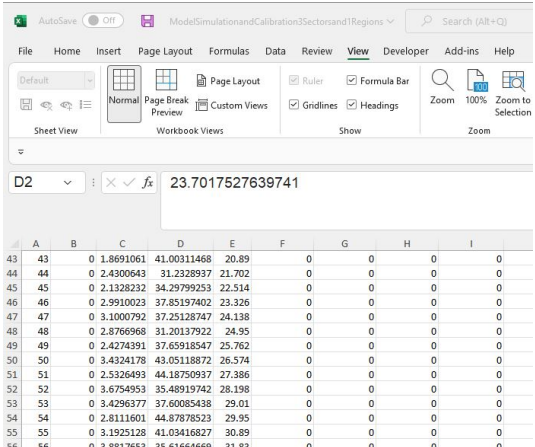


Task 9: Conduct sensitivity analysis for damages caused by storms to housing.

- Define the scenarios SSP119stormhigh, SSP245stormhigh, SSP585stormhigh.
- Replace the storm variable in the respective scenario sheets with the 95 percent value in the sheet Storms in column D in the ClimateVariables.xlsx file.
- Run simulation.

Task 9: Create the sheets for SSP585stormhigh, SSP245stormhigh and SSP119stormhigh

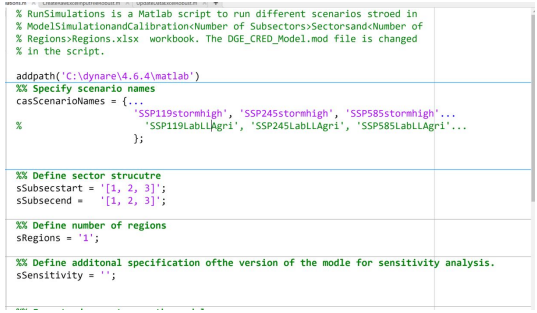
- Copy the affected persons for the 95 percent interval from the sheet storms in the ClimateVariables.xlsx file.



	A	B	C	D	E	F	G	H	I
43	43	0	1.8691061	41.00311468	20.89	0	0	0	0
44	44	0	2.4300643	31.2328937	21.702	0	0	0	0
45	45	0	2.1328232	34.29799253	22.514	0	0	0	0
46	46	0	2.9910023	37.85197402	23.326	0	0	0	0
47	47	0	3.1000792	37.25128747	24.138	0	0	0	0
48	48	0	2.8766968	31.20137922	24.95	0	0	0	0
49	49	0	2.4274391	37.65918547	25.762	0	0	0	0
50	50	0	3.4324178	43.05118872	26.574	0	0	0	0
51	51	0	2.5326493	44.18750937	27.386	0	0	0	0
52	52	0	3.6754953	35.48919742	28.198	0	0	0	0
53	53	0	3.4296377	37.60085438	29.01	0	0	0	0
54	54	0	2.8111601	44.87878523	29.95	0	0	0	0
55	55	0	3.1925128	41.03416827	30.89	0	0	0	0
56	56	0	2.8817653	35.61664669	31.83	0	0	0	0

Task 9: Execute the RunSimulation.m file

- Make sure to rename the scenario names.



```
% RunSimulations is a Matlab script to run different scenarios stroed in
% ModelSimulationandCalibration<Number of Subsectors>Sectorsand<Number of
% Regions>Regions.xlsx  workbook. The DGE_CRED_Model.mod file is changed
% in the script.

addpath('C:\dynare\4.6.4\matlab')
%% Specify scenario names
casScenarioNames = {...
                    'SSP119stormhigh', 'SSP245stormhigh', 'SSP585stormhigh'...
%                     'SSP119LabLLAgri', 'SSP245LabLLAgri', 'SSP585LabLLAgri'...
                   };


%% Define sector strucutre
sSubsecstart = '[1, 2, 3]';
sSubsecend =   '[1, 2, 3]';

%% Define number of regions
sRegions = '1';

%% Define additonal specification ofthe version of the modle for sensitivity analysis.
sSensitivity = '';
```

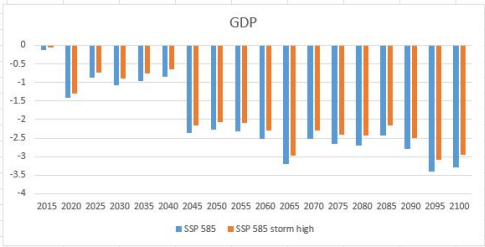
Task 9: Create a Figure comparing GDP and consumption losses for 50 percentile and 95 percentile storms.

- You need to create a sheet in Figures.xlsx as previously.

		Y	Y	Y	Y	C	C	C	C
	Year	Baseline	SSP585	Baseline	SSP585sto	Baseline	SSP585	Baseline	SSP585stormhigh
	2014	1.16534	1.16534	1.165337639	1.16534	0.7262	0.7262	0.7262	0.7262
ResultsSce	2015	1.24748	1.2458	1.24748146	1.24675	0.77872	0.77096	0.77872	0.76997
	2020	1.67999	1.65626	1.679994099	1.65806	1.01493	0.9944	1.01493	0.99283
	2025	2.12618	2.10773	2.12618437	2.11064	1.22827	1.20336	1.22827	1.20157
	2030	2.55882	2.53131	2.558816725	2.53565	1.44014	1.40721	1.44014	1.40518
	2035	2.95815	2.92996	2.958147834	2.93541	1.65755	1.60839	1.65755	1.60638
	2040	3.3127	3.28489	3.312699892	3.29155	1.87203	1.82039	1.87203	1.81816
	2045	3.61804	3.53267	3.618042767	3.53997	2.07179	1.99841	2.07179	1.99622
	2050	3.87481	3.78635	3.874810724	3.79443	2.24923	2.16287	2.24923	2.16057
	2055	4.08675	3.99218	4.08675223	4.00115	2.40159	2.3009	2.40159	2.29833
	2060	4.25918	4.15141	4.259177837	4.161	2.52936	2.41368	2.52936	2.41106
	2065	4.39788	4.25696	4.397884603	4.26743	2.63469	2.49744	2.63469	2.49437
	2070	4.5085	4.39431	4.508495013	4.40509	2.72044	2.57827	2.72044	2.57537
	2075	4.5961	4.4737	4.596103793	4.48515	2.78955	2.6435	2.78955	2.6404
	2080	4.66513	4.53955	4.665130031	4.5518	2.84479	2.70051	2.84479	2.6971
	2085	4.71929	4.60491	4.7192939	4.61757	2.88867	2.73508	2.88867	2.73186
	2090	4.76166	4.62841	4.761661412	4.64222	2.9233	2.76144	2.9233	2.75766
	2095	4.79472	4.63201	4.794720692	4.64616	2.9505	2.77113	2.9505	2.76762
	2100	4.82047	4.66233	4.820467938	4.67789	2.97176	2.77794	2.97176	2.77343
				GDP		Consumption			
			SSP 585	SSP 585 storm high	SSP 585	SSP 585 storm high			
		2015	-0.13485	-0.058469237	-0.9974	-1.12378			
		2020	-1.41254	-1.305747056	-2.02234	-2.1771			
		2025	-0.86801	-0.731143018	-2.02822	-2.17367			
		2030	-1.07491	-0.905344369	-2.28656	-2.42758			
		2035	-0.95302	-0.768523258	-2.96592	-3.08734			
		2040	-0.83962	-0.638363448	-2.75853	-2.87775			
		2045	-2.35973	-2.157812122	-3.54192	-3.64758			
		2050	-2.28295	-2.074340462	-3.83977	-3.94174			
		2055	-2.31402	-2.094530324	-4.19294	-4.29992			
		2060	-2.53017	-2.305058587	-4.57363	-4.67704			
		2065	-3.20441	-2.966196528	-5.2096	-5.32617			
		2070	-2.53273	-2.293580198	-5.22608	-5.33271			
		2075	-2.66326	-2.414100851	-5.23543	-5.34647			
		2080	-2.69195	-2.429276285	-5.07196	-5.19193			
		2085	-2.42369	-2.155492642	-5.31685	-5.42826			
		2090	-2.7984	-2.508404399	-5.53676	-5.66608			

Task 9: GDP effects vs. Consumption

- Consumption effects are higher, and GDP effects are lower.



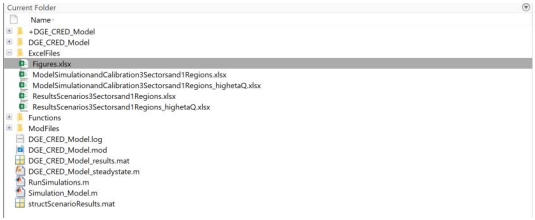
Task 10: Conduct sensitivity analysis for low and high values for the elasticity of substitution between different domestic sectors.

- Copy excel file and rename it to ModelSimulationandCalibration3Sectorsand1Regions_etaQhigh.xlsx.
- The degree of substitutability is given by $\frac{\eta^Q - 1}{\eta^Q}$.
- Estimation results suggest very low values of η^Q (etaQ_p).
- So far we assumed a value of $\eta^Q = 0.01$.
- Set the value to 10 and analyse the impact.
- What is your initial hypothesis about the GDP impact for high and low elasticity of substitution?

$$Q_t^D = \left(\sum_k^K \omega_k^{Q^A \frac{1}{\eta^Q}} \; Q_{k,t}^{A,D \frac{\eta^Q - 1}{\eta^Q}} \right)^{\frac{\eta^Q}{\eta^Q - 1}} \quad (1)$$

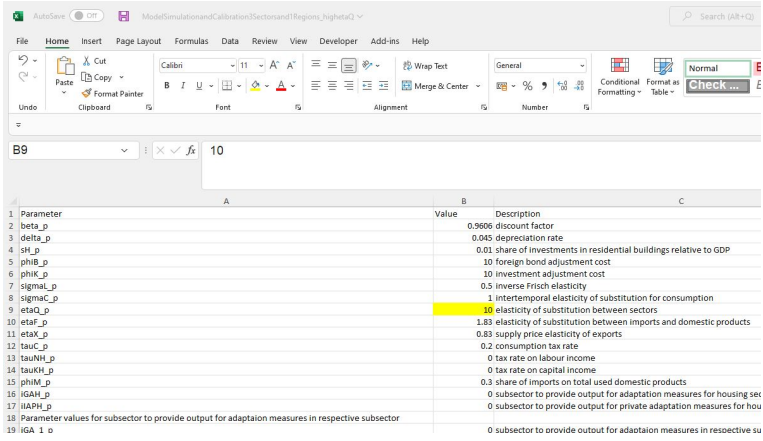
Task 10: Copy the ModelSimulationandCalibration3Sectorsand1Regions.xlsx file.

- Rename the copy to ModelSimulationandCalibration3Sectorsand1Regions_etaQhigh.xlsx of You need to create a sheet in Figures.xlsx as previously.



Task 10: Set the value for etaQ_p.

- Change the value of etaQ_p from 0.01 to 10 in the Structural Parameters sheet.

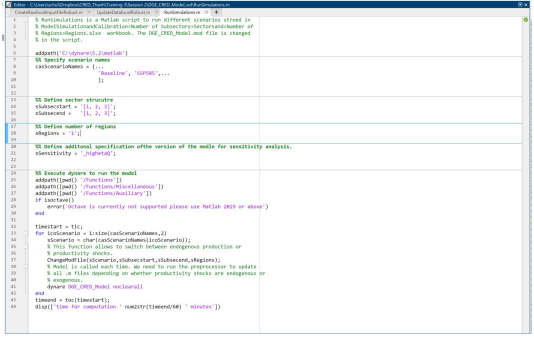


B9: 10

	A	B	C
1	Parameter	Value	Description
2	beta_p	0.9606	discount factor
3	delta_p	0.045	depreciation rate
4	sH_p	0.01	share of investments in residential buildings relative to GDP
5	phiB_p	10	foreign bond adjustment cost
6	phiK_p	10	investment adjustment cost
7	sigmaL_p	0.5	inverse Frisch elasticity
8	sigmaC_p	1	intertemporal elasticity of substitution for consumption
9	etaQ_p	10	elasticity of substitution between sectors
10	etaF_p	1.83	elasticity of substitution between imports and domestic products
11	etaX_p	0.83	supply price elasticity of exports
12	tauC_p	0.2	consumption tax rate
13	tauNH_p	0	tax rate on labour income
14	tauKH_p	0	tax rate on capital income
15	phiM_p	0.3	share of imports on total used domestic products
16	iGAH_p	0	subsector to provide output for adaptation measures for housing sec
17	iIAPH_p	0	subsector to provide output for private adaptation measures for hou
18	Parameter values for subsector to provide output for adaptaion measures in respective subsector		
19	iGA_1_p	0	subsector to provide outout for adaptaion measures in respective su

Task 10: Execute the RunSimulation.m file.

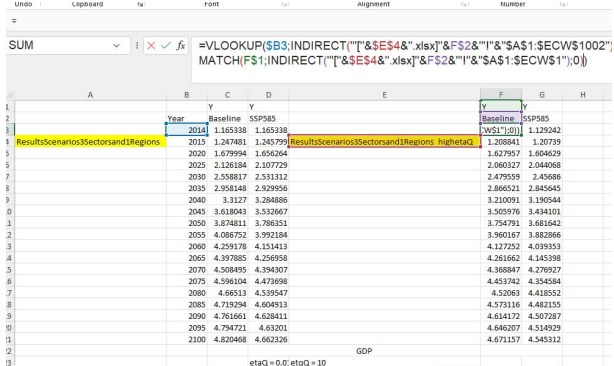
- Change the scenarios you want to simulate, and do not forget to include the Baseline scenario.



```
% RunSimulations is a Matlab script to run different scenarios stored in
% ModelSimulationsandCalibration\Number of Subsectors+Sectorsand<Number of
% Regions+Regions.xlsx  workbook. The DGE_CRED_Model.mod file is changed
% in the script.

addpath('C:\dynare\5.2\matlab')
%% Specify scenario names
casScenarioNames = {...
                    'Baseline', 'SSPSR5',...
                    };

%% Define sector strucutre
sSubsectstart = '[1, 2, 3]';
sSubsecend =    '[1, 2, 3]';

%% Define number of regions
sRegions = '1';

%% Define additional specification ofthe version of the modle for sensitivity analysis.
sSensitivity = '_HighMetaQ';

%% Execute dynare to run the model
addpath([pwd() '/Functions'])
addpath([pwd() '/Functions/Miscellaneous'])
addpath([pwd() '/Functions/Auxiliary'])
if isoctave()
    error('Octave is currently not supported please use Matlab 2019 or above')
end

timestart = tic;
for iCoScenario = 1:size(casScenarioNames,2)
    sScenario = char(casScenarioNames(iCoScenario));
    % This function allows to switch between endogenous production or
    % productivity shocks.
    ChangeModFile(sScenario,sSubsectstart,sSubsecend,sRegions);
    % Model is called each time. We need to run the preprocessor to update
    % all .m files depending on whether productivity shocks are endogenous or
    % exogenous.
    dynare DGE_CRED_Model noclearall
end
timeend = toc(timestart);
disp(['time for computation ' num2str(timeend/60) ' minutes'])
```

Task 10: Compare the results for low and high etaQ_p.

- Create a new sheet in Figures.xlsx.
- List GDP for Baseline and SSP 585 scenario next to each other.
- Copy the range and change the reference to the ResultsScenarios3Sectorsand1Regions_etaQhigh.xlsx in E4 and change the formula accordingly (replace $A$4 by $E$4)



Task 10: GDP effects are lower for a higher elasticity of substitution between sectors.

- A higher substitutability implies that damages in more severely affected sectors can be compensated with production from other sectors.