DGE–CRED Practice Session 6: Scenario Analyses

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giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

IWH Halle Institute for Economic Research
Member of the Leibniz Association

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 I

1. Task 1: Run the Baseline scenario
2. Task 2: COVID–19
3. Task 3: Calibrate the damage functions for the agricultural sector.
4. Task 4: RCP 8.5 average
5. Task 5: Impact of temperature on the industry sector.
6. Task 6: Sea level rise and the agricultural sector.

Outline II

Outline

1. Task 1: Run the Baseline scenario

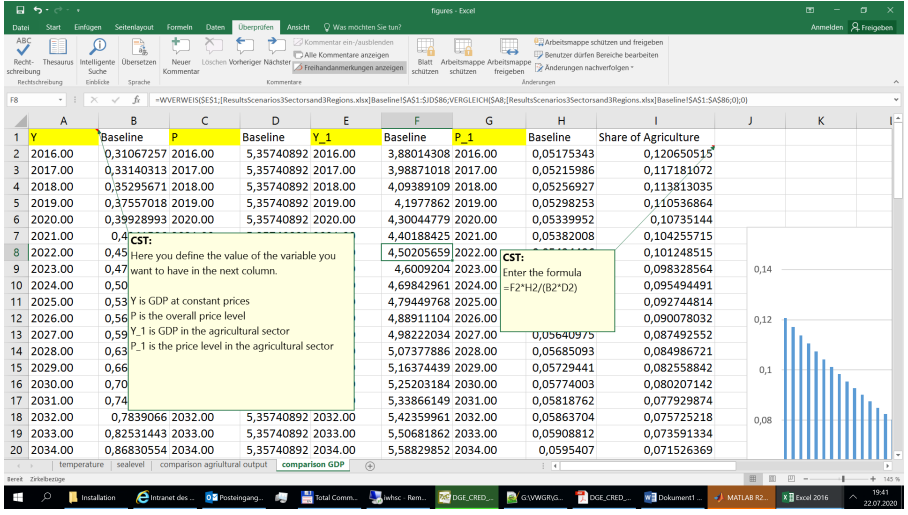
Task 1: Run only the `Baseline` scenario for the DGE–CRED model.

- Make sure that the number of sectors and regions is 3, respectively.
- Modify the `RunSimulations.m` file.
- Plot the national share of agriculture to GDP with the Excel file `Results3Scetors3Regions.xlsx`.

Solution Task 1: Run only the `Baseline` scenario for the DGE–CRED model.

```
% ========================================
% === 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'};
% execute dynare to run the model
dynare DGE_CRED_Model noclearall
close all;
sVarMain = 'N_';
for icosec = 1:inbsectors_p
    for icoreg = 1:inbregions_p
        icovec = icoreg + inbregions_p * (icosec-1);
        subplot(inbsectors_p,inbregions_p,icovec);plot(eval([sVarMain num2str(icosec) '_' num2str(icoreg)
            '(1:' num2str(iTermination_p) ')' ]));title([sVarMain num2str(icosec) '_' num2str(icoreg)]);
    end
end
```

Solution Task 1: Run only the `Baseline` scenario for the DGE–CRED model. (cont.)

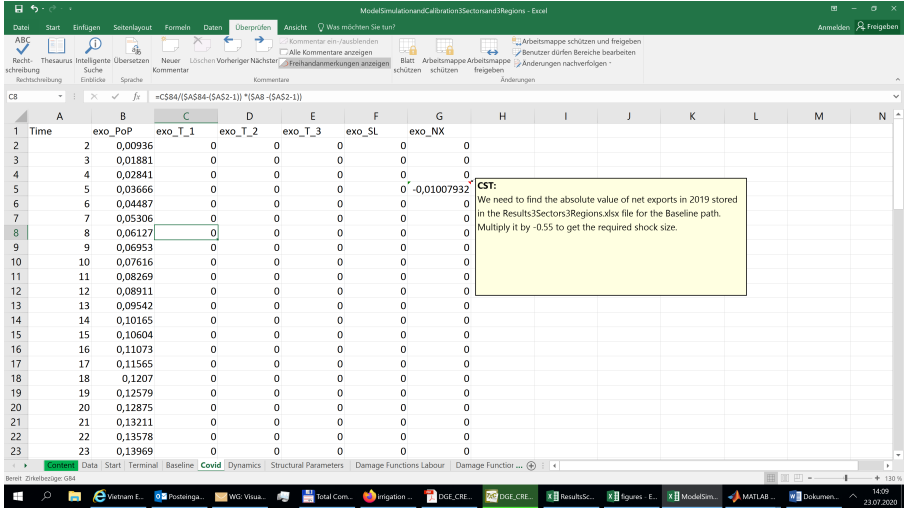


Outline

Task 2: Try to include the impact of COVID–19.

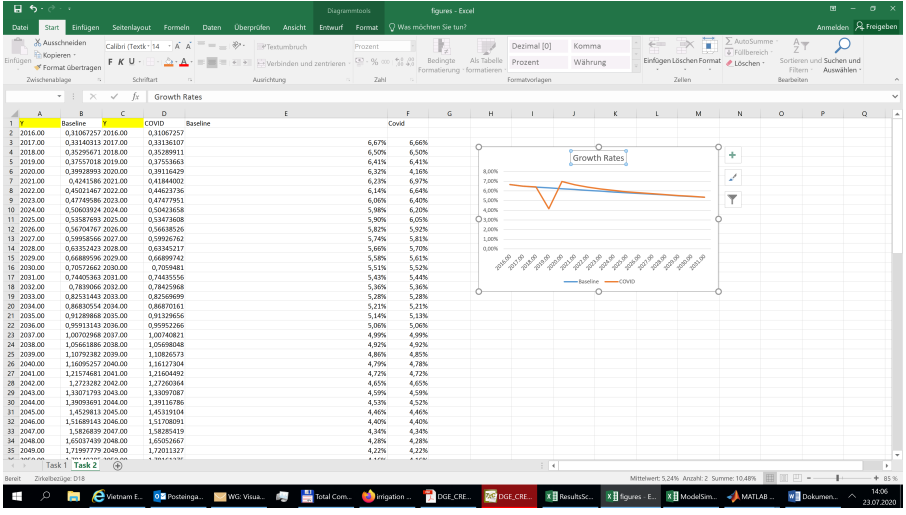
- *The Economist* assumes a decline in net exports by 55% in 2020 compared to 2019. Source: `https://country.eiu.com/vietnam`
- Define a shock `exo_NX` such that net exports are approximately 55% lower in 2020 than in 2019.
- First you should take a look at the results for the baseline scenario to define the shock size.
- Plot the growth rate of national GDP for the two scenarios.

Solution Task 2: Try to include the impact of COVID–19.



Time	exo_PoP	exo_T_1	exo_T_2	exo_T_3	exo_SL	exo_NX
2	0,00936	0	0	0	0	0
3	0,01881	0	0	0	0	0
4	0,02841	0	0	0	0	0
5	0,03666	0	0	0	0	-0,01007932
6	0,04487	0	0	0	0	0
7	0,05306	0	0	0	0	0
8	0,06127	0	0	0	0	0
9	0,06953	0	0	0	0	0
10	0,07616	0	0	0	0	0
11	0,08269	0	0	0	0	0
12	0,08911	0	0	0	0	0
13	0,09542	0	0	0	0	0
14	0,10165	0	0	0	0	0
15	0,10604	0	0	0	0	0
16	0,11073	0	0	0	0	0
17	0,11565	0	0	0	0	0
18	0,1207	0	0	0	0	0
19	0,12579	0	0	0	0	0
20	0,12875	0	0	0	0	0
21	0,13211	0	0	0	0	0
22	0,13578	0	0	0	0	0
23	0,13969	0	0	0	0	0

Solution Task 2: Try to include the impact of COVID-19. (cont.)



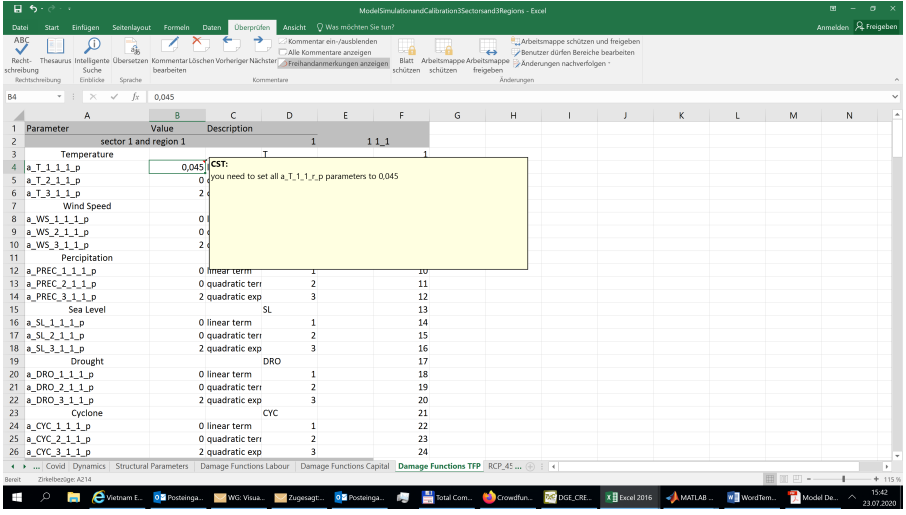
Outline

3. Task 3: Calibrate the damage functions for the agricultural sector.

Task 3: Calibrate the damage functions for the agricultural sector.

- Assume that crop yields in all regions decline by 4.5% for a one degree increase in temperature.
- What parameters need to be modified in the Excel file `ModelSimulationsandCalibration3Sectors3Regions.xlsx`?
- Define a Scenario called `RCP_45_Average` use the excel file `RCPScenarios.xlsx` and run a simulation.
- What is the impact on GDP growth rates?

Solution Task 3: Calibrate the damage functions for the agricultural sector.

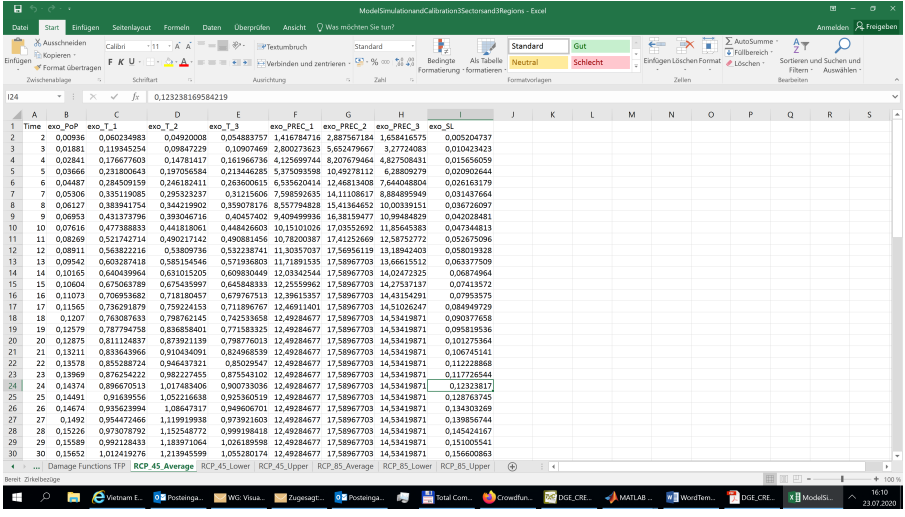


Solution Task 3: Calibrate the damage functions for the agricultural sector. (cont.)

- Copy the Baseline Sheet and rename it `RCP_45_Average` in `ModelSimulationsandCalibration3Sectors3Regions.xlsx`.
- Create columns for the change in temperature, precipitation and Sea level.
- Copy the values in `RCPScenarios.xlsx` into the respective columns.
- Change in `RunSimulations.m` the name of the scenario.

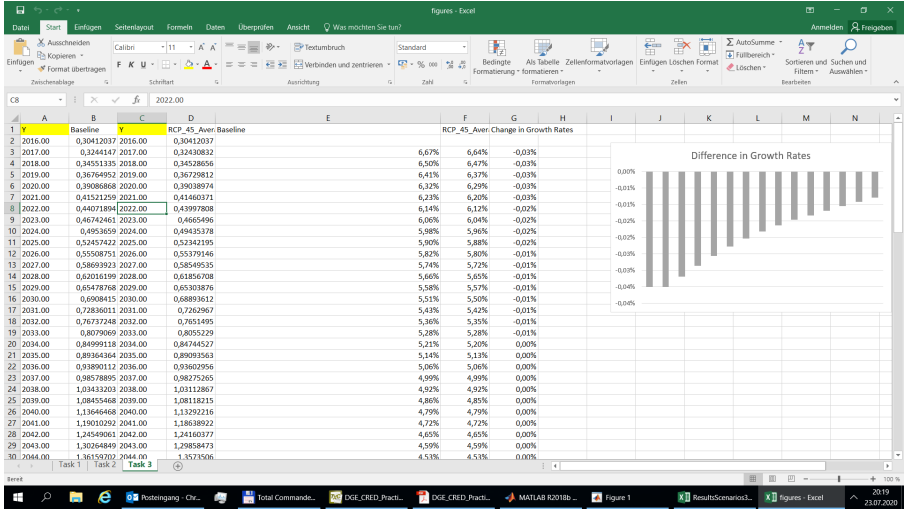
```
% specify scenario names
casScenarioNames = {'RCP_45_Average'};
```

Solution Task 3: Calibrate the damage functions for the agricultural sector. (cont.)



Time	exo_PoP	exo_T_1	exo_T_2	exo_T_3	exo_PREC_1	exo_PREC_2	exo_PREC_3	exo_SL
2	0,00936	0,060234983	0,04920008	0,054883757	1,416784716	2,887567184	1,658416575	0,005204737
3	0,01881	0,119345254	0,09847229	0,10907469	2,800273623	5,652479667	3,27724083	0,010423423
4	0,02841	0,176677603	0,14781417	0,161966736	4,125699744	8,207679464	4,827508431	0,015656059
5	0,03666	0,231800643	0,197056584	0,213446285	5,375093598	10,49278112	6,28809279	0,020902644
6	0,04487	0,284509159	0,246182411	0,263600615	6,535620414	12,46813408	7,644048804	0,026163179
7	0,05306	0,335119085	0,295323237	0,31215606	7,598592635	14,11108617	8,884895949	0,031437664
8	0,06127	0,383941754	0,344219902	0,359078176	8,557794828	15,41364652	10,00339151	0,036726097
9	0,06953	0,431373796	0,393046716	0,40457402	9,409499936	16,38159477	10,99484829	0,042028481
10	0,07616	0,477388833	0,441818061	0,448426603	10,15101026	17,0355269	11,85645383	0,047344813
11	0,08269	0,521742714	0,490217142	0,490881456	10,78200387	17,41252669	12,58752772	0,052675096
12	0,08911	0,563822216	0,53809736	0,532238741	11,30357037	17,56956119	13,18942403	0,058019328
13	0,09542	0,603287418	0,585154546	0,571936803	11,71891535	17,58967703	13,66615512	0,063377509
14	0,10165	0,640439964	0,631015205	0,609830449	12,03342544	17,58967703	14,02472325	0,06874964
15	0,10604	0,675063789	0,675435997	0,645848333	12,25559962	17,58967703	14,27537137	0,07413572
16	0,11073	0,706953682	0,718180457	0,679767513	12,39615357	17,58967703	14,43154291	0,07953575
17	0,11565	0,736291879	0,759224153	0,711896767	12,46911401	17,58967703	14,5102647	0,084949729
18	0,1207	0,763087633	0,798762145	0,742533658	12,49284677	17,58967703	14,53419871	0,090377658
19	0,12579	0,787794758	0,836858401	0,771583325	12,49284677	17,58967703	14,53419871	0,095819536
20	0,12875	0,811124837	0,873921139	0,798776013	12,49284677	17,58967703	14,53419871	0,101275364
21	0,13211	0,833643966	0,910434091	0,824968539	12,49284677	17,58967703	14,53419871	0,106745141
22	0,13578	0,855288724	0,946437321	0,85029547	12,49284677	17,58967703	14,53419871	0,112228868
23	0,13969	0,876254222	0,982227455	0,875543102	12,49284677	17,58967703	14,53419871	0,117726544
24	0,14374	0,896670513	1,017483406	0,900733036	12,49284677	17,58967703	14,53419871	0,12323817
25	0,14491	0,91639556	1,052216638	0,925360519	12,49284677	17,58967703	14,53419871	0,128763745
26	0,14674	0,935623994	1,08647317	0,949606701	12,49284677	17,58967703	14,53419871	0,134303269
27	0,1492	0,954472466	1,119919938	0,973921603	12,49284677	17,58967703	14,53419871	0,139856744
28	0,15226	0,973078792	1,152548772	0,999198418	12,49284677	17,58967703	14,53419871	0,145424167
29	0,15589	0,992128433	1,183971064	1,026189598	12,49284677	17,58967703	14,53419871	0,151005541
30	0,15652	1,012419276	1,213945599	1,055280174	12,49284677	17,58967703	14,53419871	0,156600863

Solution Task 3: Calibrate the damage functions for the agricultural sector. (cont.)



Outline

4. Task 4: RCP 8.5 average

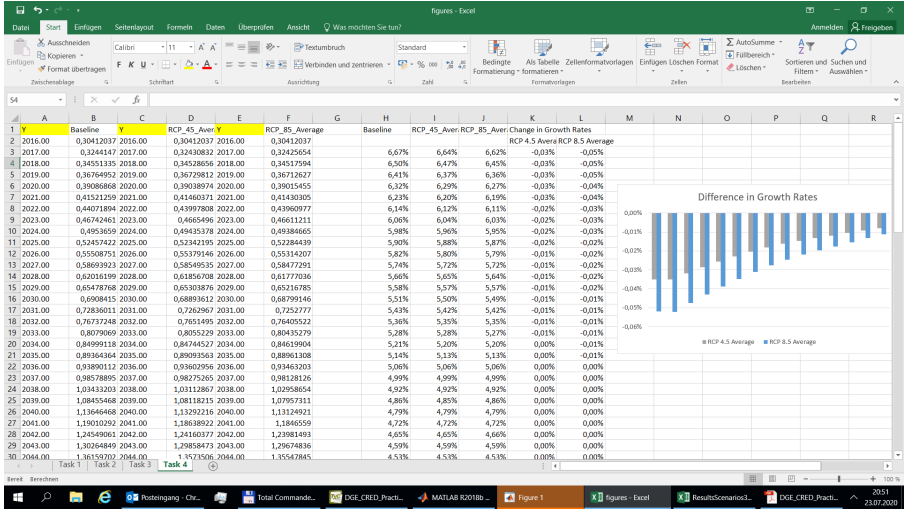
Task 4: Define the RCP 8.5 average scenario and simulate it.

- Add the Scenario to your figure for task 3.
- Why is the negative effect on GDP decreasing over time?

Solution Task 4: Define the RCP 8.5 average scenario and simulate it.

- Repeat the steps you did to create the RCP 4.5 Average scenario.
- A lower share of agriculture on total GDP leads to a lower contribution of GDP on

Solution Task 4: Define the RCP 8.5 average scenario and simulate it. (cont.)



Y	Baseline	Y	RCP_45_Aver.	Y	RCP_85_Average	Baseline	RCP_45_Aver.	RCP_85_Aver.	Change in Growth Rates	
									RCP 4.5 Avera	RCP 8.5 Average
2016.00	0,30412037	2016.00	0,30412037	2016.00	0,30412037					
2017.00	0,3244147	2017.00	0,32438832	2017.00	0,32425654	6,67%	6,64%	6,62%	-0,03%	-0,05%
2018.00	0,34551335	2018.00	0,34528656	2018.00	0,34517594	6,50%	6,47%	6,45%	-0,03%	-0,05%
2019.00	0,36764952	2019.00	0,36729812	2019.00	0,36712627	6,41%	6,37%	6,36%	-0,03%	-0,05%
2020.00	0,39086868	2020.00	0,39038974	2020.00	0,39015455	6,32%	6,29%	6,27%	-0,03%	-0,04%
2021.00	0,41521259	2021.00	0,41460371	2021.00	0,41430305	6,23%	6,20%	6,19%	-0,03%	-0,04%
2022.00	0,44071894	2022.00	0,43997808	2022.00	0,43960977	6,14%	6,12%	6,11%	-0,02%	-0,03%
2023.00	0,46742461	2023.00	0,4665496	2023.00	0,46611211	6,06%	6,04%	6,03%	-0,02%	-0,03%
2024.00	0,4953659	2024.00	0,49433578	2024.00	0,49384665	5,98%	5,96%	5,95%	-0,02%	-0,03%
2025.00	0,52457422	2025.00	0,52342195	2025.00	0,52284439	5,90%	5,88%	5,87%	-0,02%	-0,02%
2026.00	0,55508751	2026.00	0,55379146	2026.00	0,55314207	5,82%	5,80%	5,79%	-0,01%	-0,02%
2027.00	0,58693923	2027.00	0,58549535	2027.00	0,58477291	5,74%	5,72%	5,72%	-0,01%	-0,02%
2028.00	0,62016199	2028.00	0,61856708	2028.00	0,61777036	5,66%	5,65%	5,64%	-0,01%	-0,02%
2029.00	0,65478768	2029.00	0,65303876	2029.00	0,65216785	5,58%	5,57%	5,57%	-0,01%	-0,02%
2030.00	0,6908415	2030.00	0,68893612	2030.00	0,68799146	5,51%	5,50%	5,49%	-0,01%	-0,01%
2031.00	0,72836011	2031.00	0,7262967	2031.00	0,7252777	5,43%	5,42%	5,42%	-0,01%	-0,01%
2032.00	0,76737248	2032.00	0,7651495	2032.00	0,76405522	5,36%	5,35%	5,35%	-0,01%	-0,01%
2033.00	0,8079069	2033.00	0,8055229	2033.00	0,80435279	5,28%	5,28%	5,27%	-0,01%	-0,01%
2034.00	0,84999118	2034.00	0,84744527	2034.00	0,84619904	5,21%	5,20%	5,20%	0,00%	-0,01%
2035.00	0,89364364	2035.00	0,89093563	2035.00	0,88961308	5,14%	5,13%	5,13%	0,00%	-0,01%
2036.00	0,93890112	2036.00	0,93602956	2036.00	0,93463203	5,06%	5,06%	5,06%	0,00%	0,00%
2037.00	0,98578895	2037.00	0,98275265	2037.00	0,98128126	4,99%	4,99%	4,99%	0,00%	0,00%
2038.00	1,03433203	2038.00	1,03112867	2038.00	1,02958054	4,92%	4,92%	4,92%	0,00%	0,00%
2039.00	1,08455468	2039.00	1,08118215	2039.00	1,07957311	4,86%	4,85%	4,86%	0,00%	0,00%
2040.00	1,13646468	2040.00	1,13292216	2040.00	1,13124921	4,79%	4,79%	4,79%	0,00%	0,00%
2041.00	1,19010292	2041.00	1,18638922	2041.00	1,1846559	4,72%	4,72%	4,72%	0,00%	0,00%
2042.00	1,24549061	2042.00	1,24160377	2042.00	1,23981493	4,65%	4,65%	4,66%	0,00%	0,00%
2043.00	1,30264849	2043.00	1,29858473	2043.00	1,29674836	4,59%	4,59%	4,59%	0,00%	0,00%
2044.00	1,36159702	2044.00	1,3573506	2044.00	1,35547845	4,53%	4,53%	4,53%	0,00%	0,00%

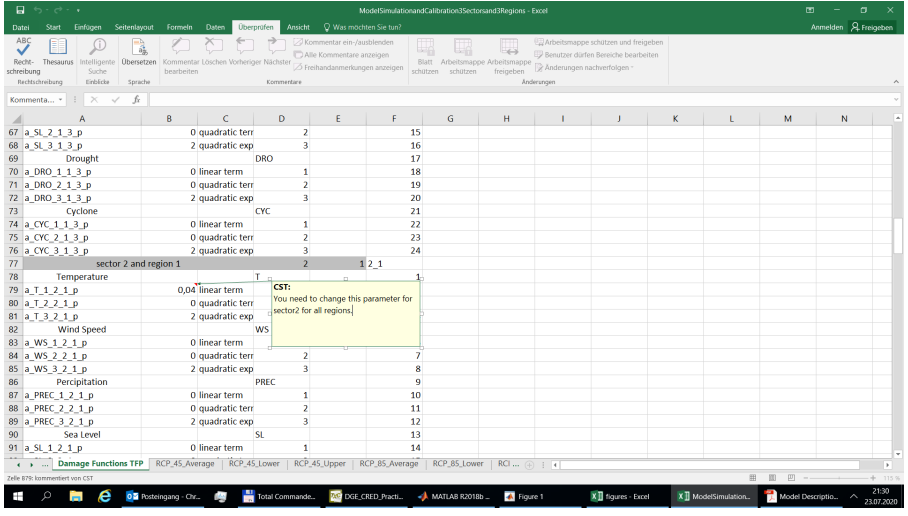
Outline

5. Task 5: Impact of temperature on the industry sector.

Task 5: Impact of temperature on the industry sector.

- Assume that with a one degree increase in temperature total factor productivity declines by 4%.
- Modify the respective damage functions coefficients.

Solution Task 5:



Outline

6. Task 6: Sea level rise and the agricultural sector.

Task 6: Sea level rise and the agricultural sector.

- 39% of agricultural land in the Mekong River Delta is at risk of inundation if the sea level rises by 100 cm.
- A 100 cm increase in sea level exposes about 16% of the agricultural land in the Red River Delta.
- For other regions only 2% of agricultural land is at risk of inundation.
- Modify the respective damage coefficients.

Solution Task 6: Sea level rise and the agricultural sector.

- set `a_SL_1_1_1_p` to 0.39.
- set `a_SL_1_1_2_p` to 0.16
- set `a_SL_1_1_3_p` to 0.02

Outline

7. Task 7: Building a dike in the Mekong River Delta.

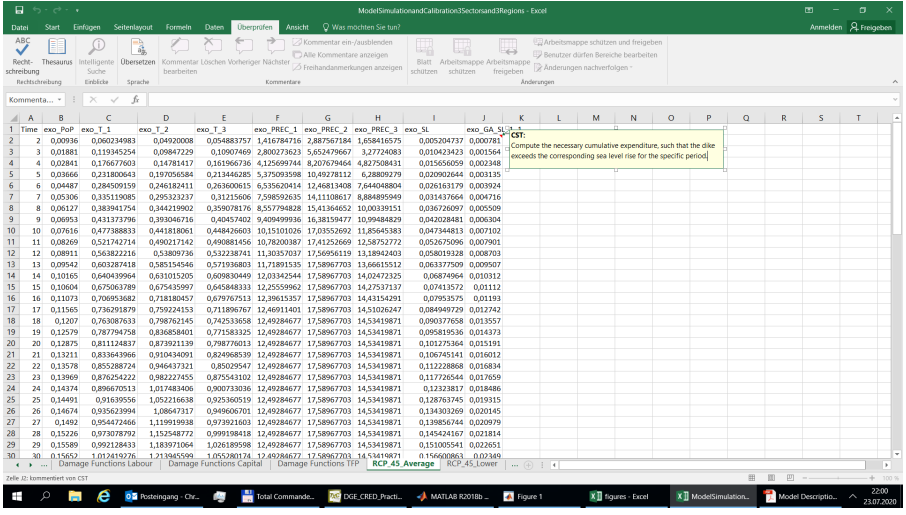
Task 7: Building a dike in the Mekong River Delta.

- A dike is a capital good which needs maintenance.
- The coastline of the Mekong River Delta is 600 km long.
- Building a dike along the coastline of the Mekong River Delta of one meter height costs roughly 24 billion Euro or roughly 15% of the GDP of Vietnam in 2016.
- We assume that the damage caused by inundation can be reduced to zero if the height of the dike exceeds the change in sea level.

Solution Task 7: Building a dike in the Mekong River Delta.

- First specify a value for `phiGASL_1_1_p` such that cumulative adaptation expenditures exceed 15% for a 1m increase in sea level. Therefore set `phiGASL_1_1_p` to 0.15.
- Now specify a expenditure path for `exo_GASL_1_1`, such that cumulative expenditures ensure that the dike is high enough.

Solution Task 7: Building a dike in the Mekong River Delta. (cont.)



Time	exo_PoP	exo_T_1	exo_T_2	exo_T_3	exo_PREC_1	exo_PREC_2	exo_PREC_3	exo_SL	exo_GA_SL
2	0,00936	0,060234995	0,04920008	0,054883757	1,416784716	2,887567184	1,658416575	0,005204737	0,000781
3	0,01881	0,119345254	0,09847229	0,10907469	2,800273623	5,652479667	3,27724083	0,010423423	0,001564
4	0,02841	0,176677603	0,14781417	0,161966736	4,125699744	8,207679464	4,827508431	0,015656059	0,002348
5	0,03666	0,231800643	0,197056584	0,213446285	5,375093598	10,49278112	6,28809279	0,020902644	0,003135
6	0,04487	0,284509159	0,246182411	0,263600615	6,535620414	12,46813408	7,644048804	0,026163179	0,003924
7	0,05306	0,335119085	0,295323237	0,31215606	7,598592635	14,11108617	8,884895949	0,031437664	0,004716
8	0,06127	0,383941754	0,344219002	0,359078176	8,557794828	15,41364652	10,00339151	0,036726097	0,005509
9	0,06953	0,431373796	0,393046716	0,40457402	9,409499936	16,38159477	10,99484829	0,042028481	0,006304
10	0,07616	0,477388833	0,441818061	0,448426603	10,15101026	17,03552692	11,85645383	0,047344813	0,007102
11	0,08269	0,521742714	0,490217142	0,490881456	10,78200387	17,41252669	12,58752772	0,052675096	0,007901
12	0,08911	0,563822216	0,53809736	0,532238741	11,30357037	17,56956119	13,18942403	0,058019328	0,008703
13	0,09542	0,603287418	0,585154946	0,571936803	11,71891835	17,58967703	13,66615512	0,063377509	0,009507
14	0,10165	0,640439964	0,631015205	0,609830449	12,03342544	17,58967703	14,02472325	0,06874964	0,010312
15	0,10604	0,675063789	0,675435997	0,645848333	12,25559962	17,58967703	14,27537137	0,07413572	0,01112
16	0,11073	0,706953682	0,718180457	0,679767513	12,39615357	17,58967703	14,43154291	0,07953575	0,01193
17	0,11565	0,736291879	0,759224153	0,711896767	12,46911401	17,58967703	14,51026247	0,084949729	0,012742
18	0,1207	0,763087633	0,798762145	0,742533658	12,49284677	17,58967703	14,53419871	0,090377658	0,013557
19	0,12579	0,787794758	0,836858401	0,771583325	12,49284677	17,58967703	14,53419871	0,095819536	0,014373
20	0,12875	0,811124837	0,873921139	0,798776013	12,49284677	17,58967703	14,53419871	0,101275364	0,015191
21	0,13211	0,833643966	0,910434091	0,824968539	12,49284677	17,58967703	14,53419871	0,106745141	0,016012
22	0,13578	0,855288724	0,946437321	0,85029547	12,49284677	17,58967703	14,53419871	0,112228868	0,016834
23	0,13969	0,876254222	0,982227455	0,875543102	12,49284677	17,58967703	14,53419871	0,117726544	0,017659
24	0,14374	0,896670513	1,017483406	0,900733036	12,49284677	17,58967703	14,53419871	0,12323817	0,018486
25	0,14491	0,91639556	1,052216638	0,925360519	12,49284677	17,58967703	14,53419871	0,128763745	0,019315
26	0,14674	0,935623994	1,08647317	0,949606701	12,49284677	17,58967703	14,53419871	0,134303269	0,020145
27	0,1492	0,954472466	1,119919938	0,973921603	12,49284677	17,58967703	14,53419871	0,139856744	0,020979
28	0,15226	0,973078792	1,152548772	0,999198418	12,49284677	17,58967703	14,53419871	0,145424167	0,021814
29	0,15589	0,992128433	1,183971064	1,026189598	12,49284677	17,58967703	14,53419871	0,151005541	0,022651
30	0,15652	1,012419276	1,213965599	1,055280174	12,49284677	17,58967703	14,53419871	0,156600863	0,02349

Outline

8 Task 8: Sensitivity analysis

Task 8: Run sensitivity analysis for RCP 4.5 and 8.5.

- Define the Scenarios RCP 4.5 lower, upper and RCP 8.5 lower, upper.

Solution Task 8: Run sensitivity analysis for RCP 4.5 and 8.5.