MUG- WITCH

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The Modeling Tool

Basic structure:

- dynamic, optimal growth multi-country model (13 regions, 5 yrs time steps to 2100)
- focus on the energy sector (hard-linked)
- traces and controls all Kyoto gases
- adaptation and damage module (on/off)

Distinguishing features:

1. ETC in the energy sector (3 R&D sectors and LBD)
2. multiple externalities (climate, technology)
3. game theoretic set-up

Scenario matrix

	1	2	3	4	5
TFP	+1%	+0.5%	+0%	-0.5%	-1%
POP	+1%	+0.5%	+0%	-0.5%	-1%
TFC	+3°C	+1.5°C	0°C	-1.5°C	-3°C

Non-cooperative solution excluding climate feedback

This ppt

- focuses on TFP and POP
- illustrates concepts for extreme cases

TFP vs. POP

TFP: increase productivity of all factors, including energy

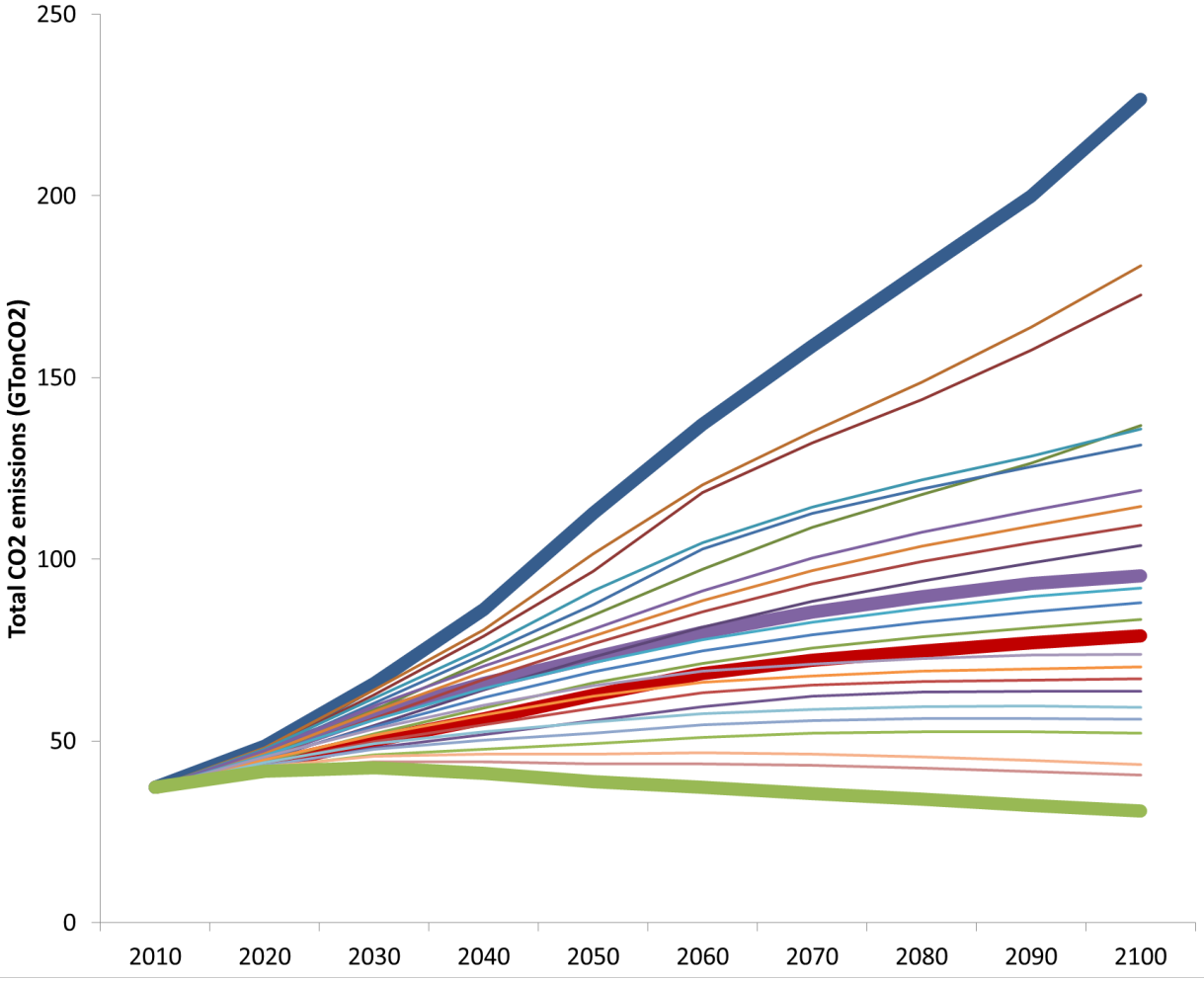
POP: energy-using since sigma<1

$$Y_{i,t} = TFP_{i,t}\left(\alpha_{KL_i}\left(K_{i,t}^{\beta} L_{i,t}^{1-\beta}\right)^{\frac{\sigma-1}{\sigma}} + \alpha_{EN_i} ES_{i,t}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

$i = 1,\ldots,13$ are the model regions

$t = 2005,\ldots,2100$

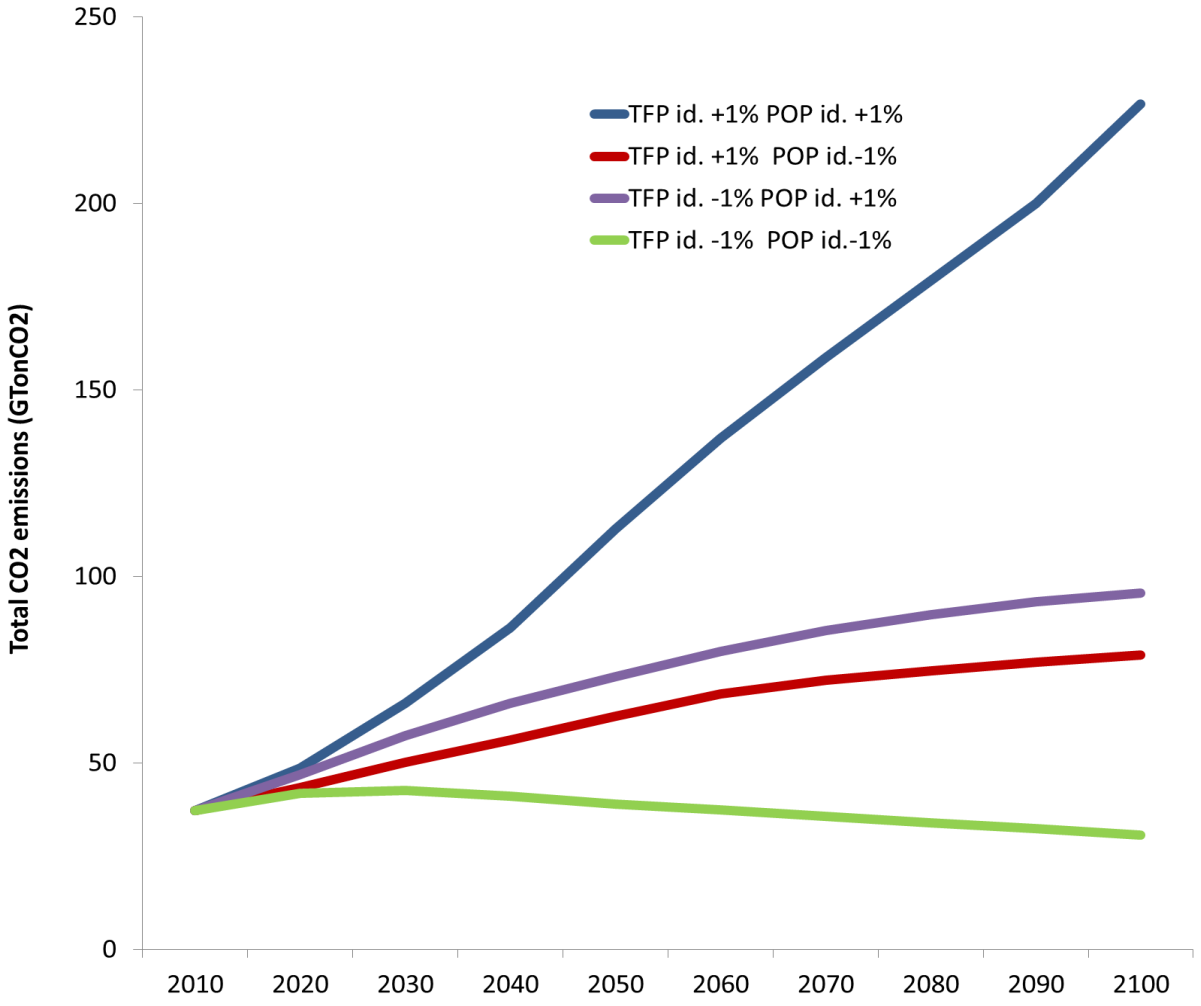
Effects of TFP vs. POP on CO2 emissions



The emission range spanned when varying TFP and POP growth is huge

196 Gton CO2 in 2100
74 Gton CO2 in 2050

Effect of TFP vs. POP on CO2 emissions

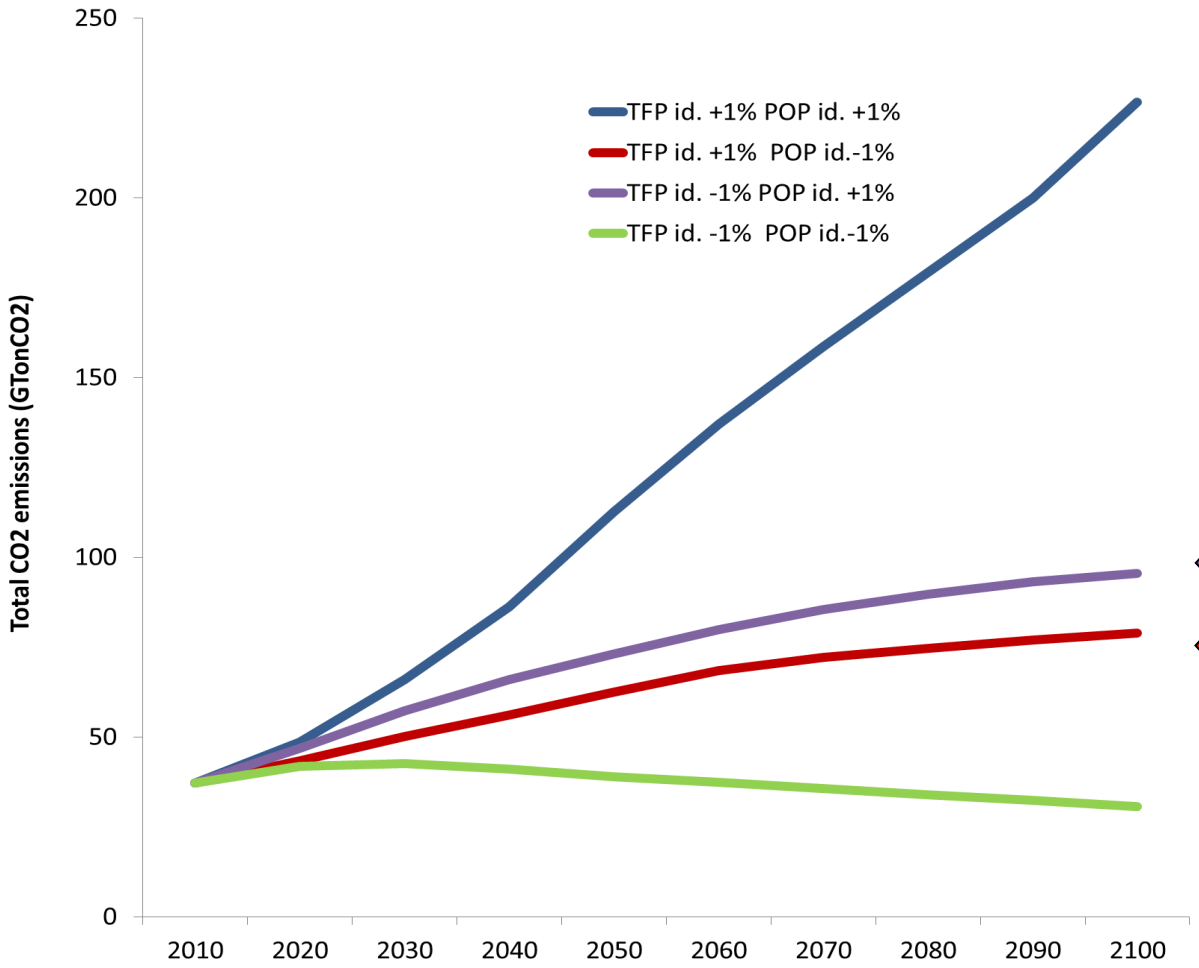


Focus on the extreme cases to illustrate

- The EMI-GDP relationship also varies

- TFP and POP have a different impact due to the neutral effect of the former and energy-using effect of the latter

Effect of TFP vs. POP on CO2 emissions



Fast pop, fast growth

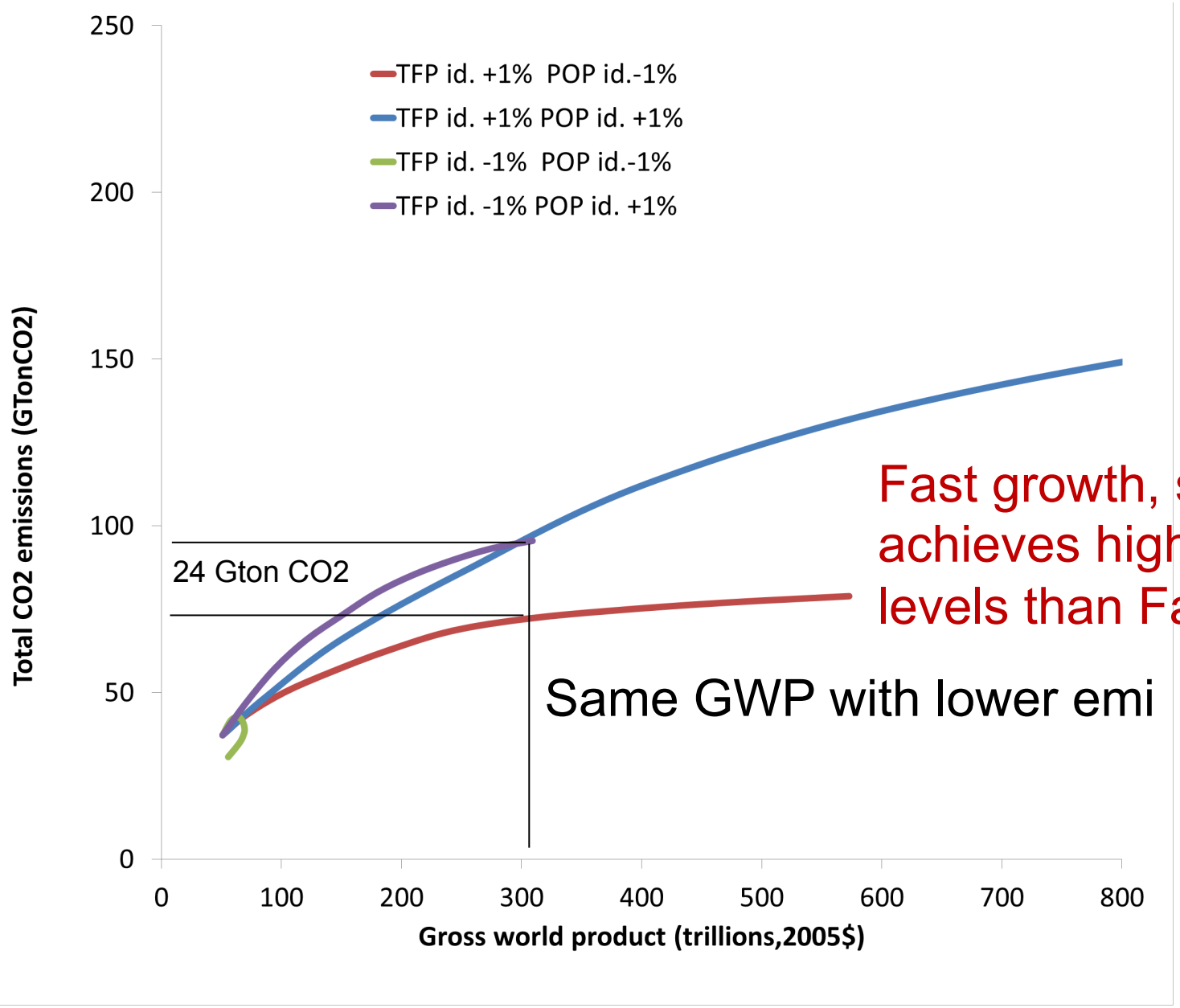
Fast pop, slow growth

Fast growth, slow pop

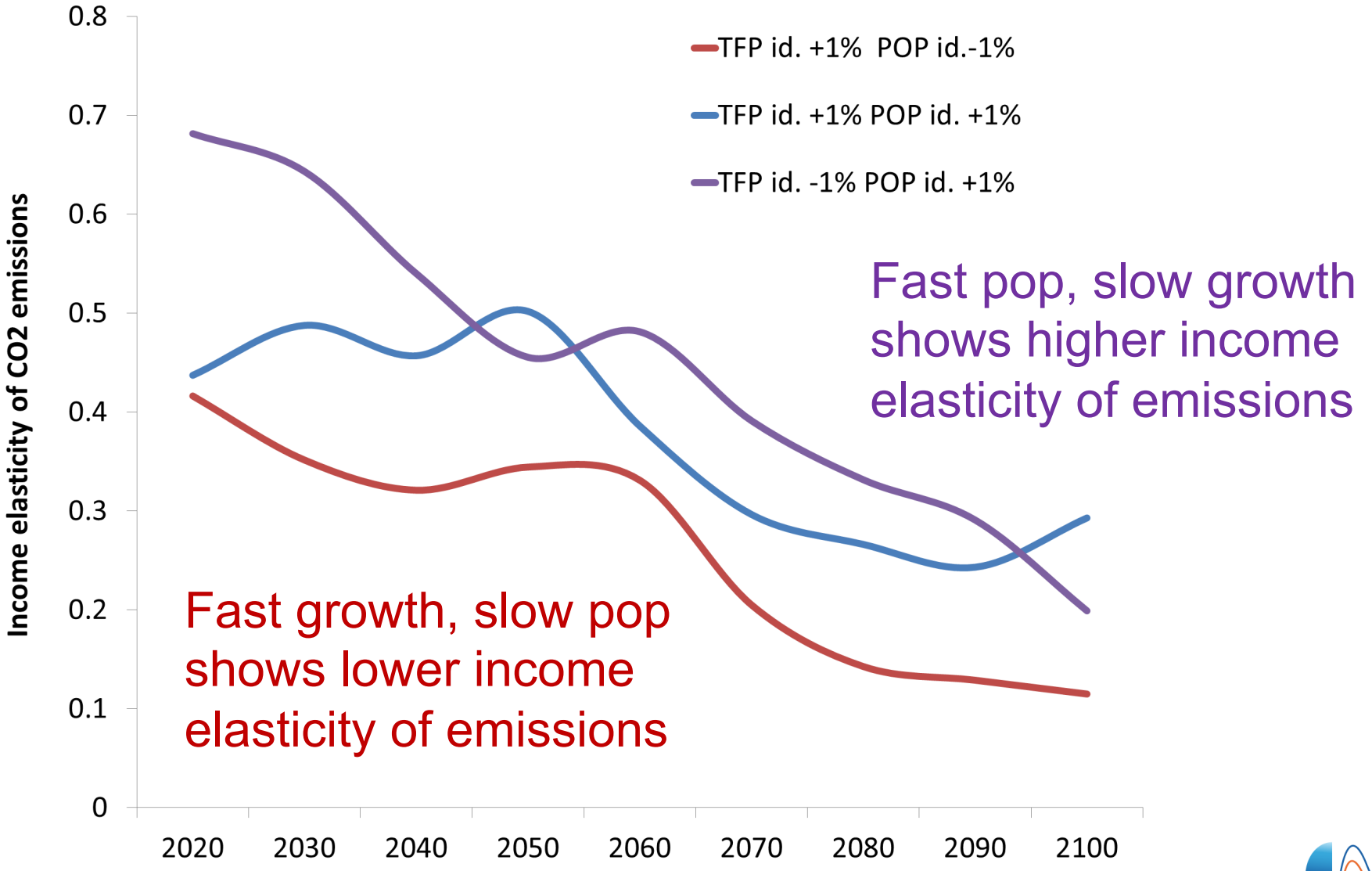
Slow pop, slow growth

Fast pop and slow growth has higher emissions than **fast growth and slow pop**
Fast growth => faster productivity improvement of all factors, including energy
Fast pop => only have a E-U effect

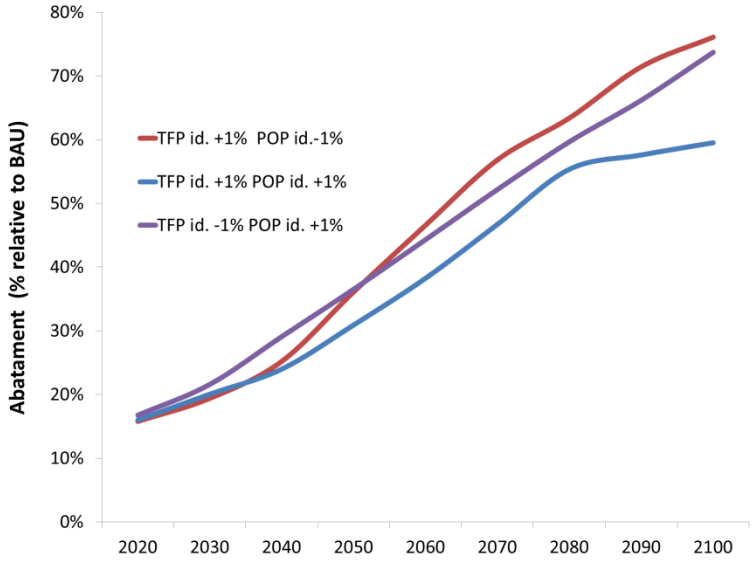
Effect of TFP vs. POP on EMI-GDP relationship



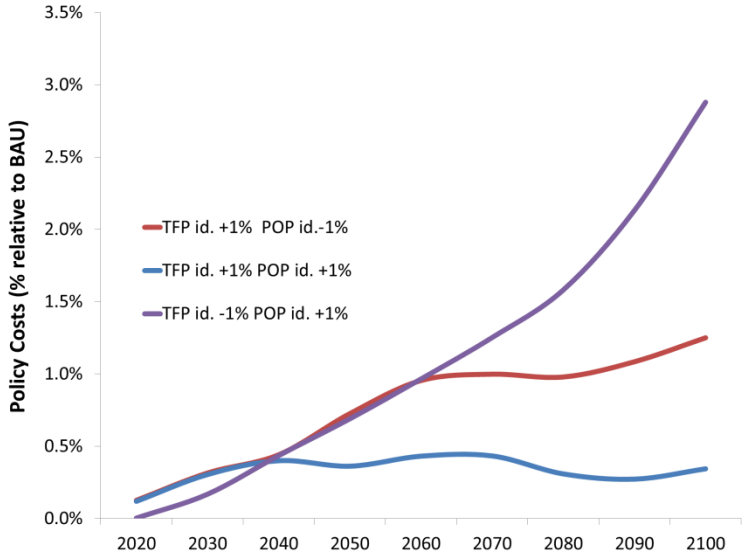
Effect of TFP vs. POP on EMI-GDP relationship



Effect of TFP vs. POP on CO2 abatement



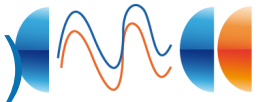
Fast growth, slow pop more abatement after 2050

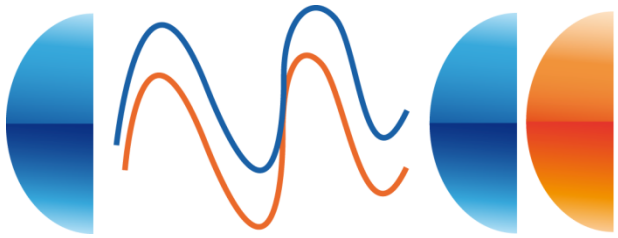


and lower policy costs (cons) after 2060

Way forward

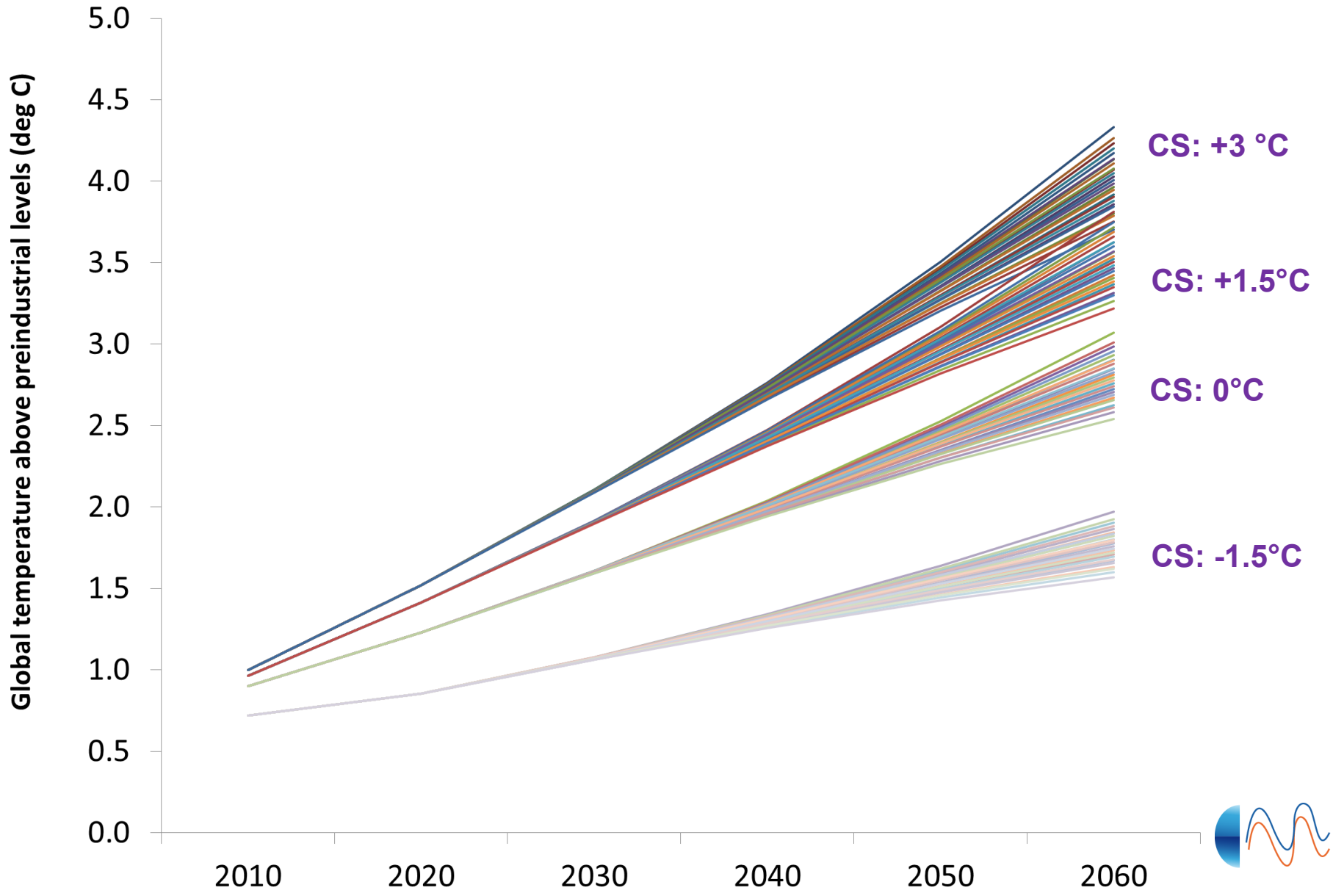
- TFP: neutral vs. labor augmenting
- Interaction effects are important given the non linear nature of our models and likely to be model-specific
- Assign probability to the various combinations, e.g. based on historical data, how likely fast pop and low TFP is? Relationship with SSP process and other projects?
- Usefulness of CS if no impacts included and CE analysis
- Can include damage and do SCC (shadow price)

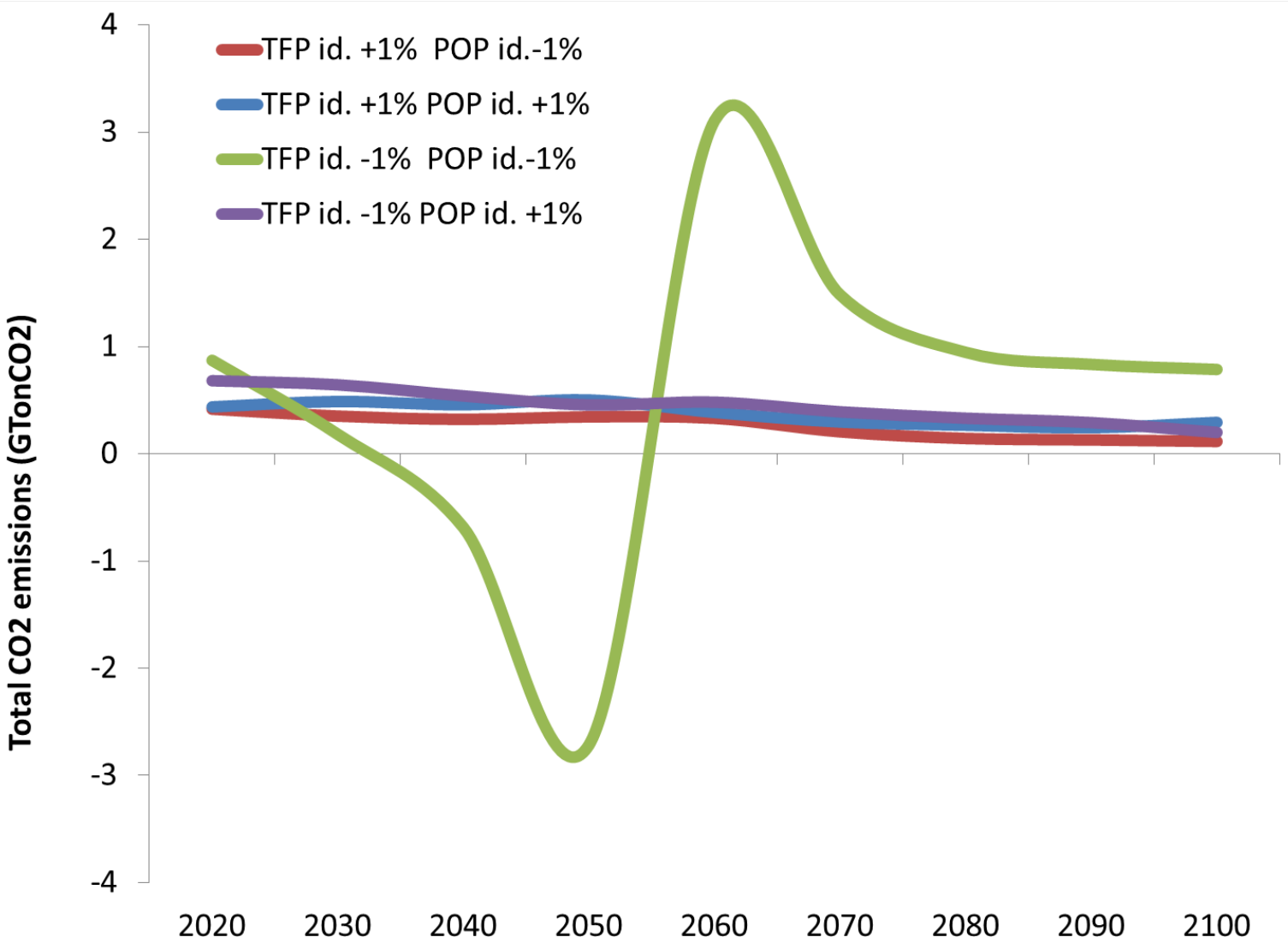




Centro Euro-Mediterraneo
sui Cambiamenti Climatici

Thanks


Global temperature above preindustrial levels (deg C)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2010
2020
2030
2040
2050
2060
CS: +3 °C
CS: +1.5°C
CS: 0°C
CS: -1.5°C


TFP id. +1% POP id.-1%
TFP id. +1% POP id. +1%
TFP id. -1% POP id.-1%
TFP id. -1% POP id. +1%
Total CO2 emissions (GTonCO2)
4
3
2
1
0
-1
-2
-3
-4
2020
2030
2040
2050
2060
2070
2080
2090
2100