Climate change exposure and macroeconomic vulnerabilities

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1.1 Conceptual framework

Measuring climate impacts

- **Climate change impacts: the need for measuring**
  - Damage functions: usually aggregate impact according to temperature change, but impacts are **structurally different across industries** (fore example, supply vs. demand impacts),
  - Cascade impacts: depending on countries' productive and commercial integration, **propagation through industries will be different**, leading to specific inter-industrial impacts
  - Economic exposure: impact analysis rely on **strong hypothesis on technological substitutability**; a step back is to look at exposure

- **Sectoral impacts and MRIO analysis**
  - We built country-by-sector damage functions to identify shocks on different industries for specific economies
  - The propagation of these shocks through the economy (in the absence of substitutability) are analysed using Multi-Regional IO tables

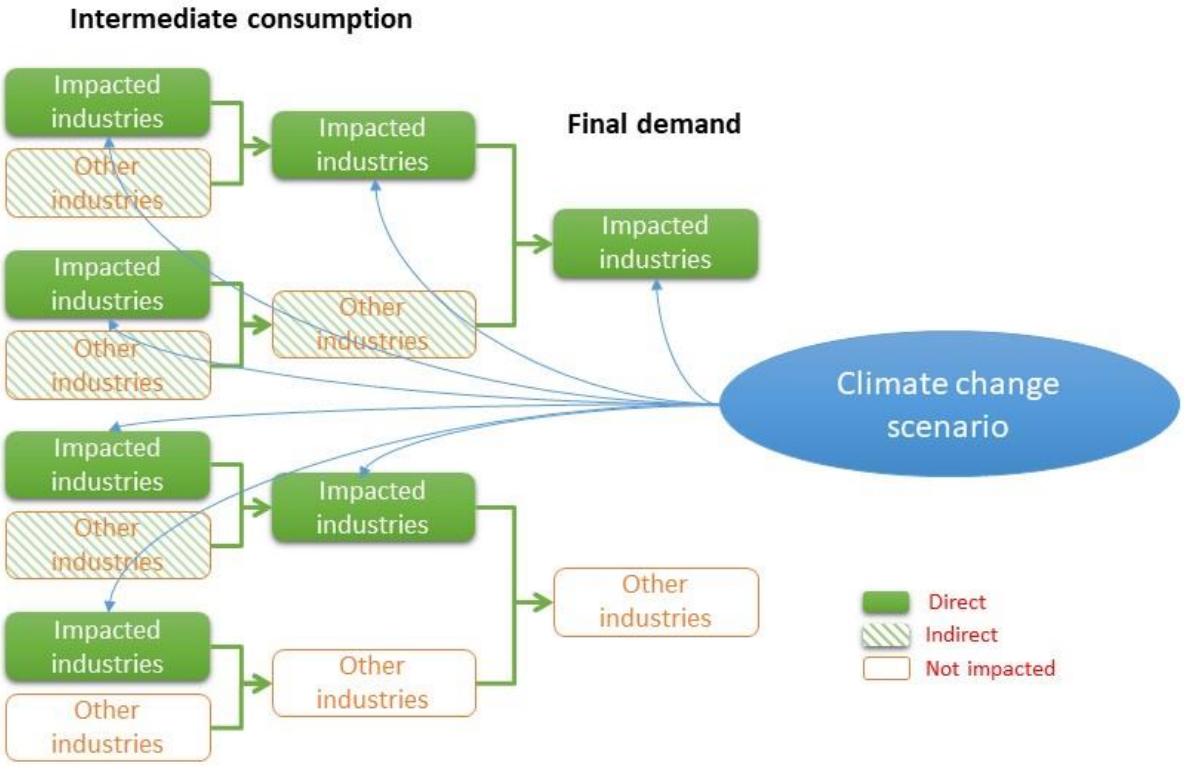
1.2 Conceptual framework

Identifying climate change direct damages

- **Industry-level**
  - Agriculture: impact of temperature increase on the change in crop yield (random-effects Bayesian hierarchical model)
  - Fisheries: how climate change will impact fisheries revenue at a local level based on sea surface temperature, sea bottom temperature and salinity
  - Energy: changes in precipitation, temperature, wind speed, runoff, solar irradiation and other parameters alter the production capacity of renewables
  - Tourism: impact of temperature increase on international tourism flows (sectoral distribution based on Tourism Satellite Accounts)
- **Non-industry level**
  - Sea-level rise: impacts of flood on assets; in a first approximation we consider that it impact proportionally all industries
  - Labour productivity: worker productivity losses accelerating under higher warming levels (not included yet)

1.3 Conceptual framework

Propagation



1.4 Conceptual framework

Method

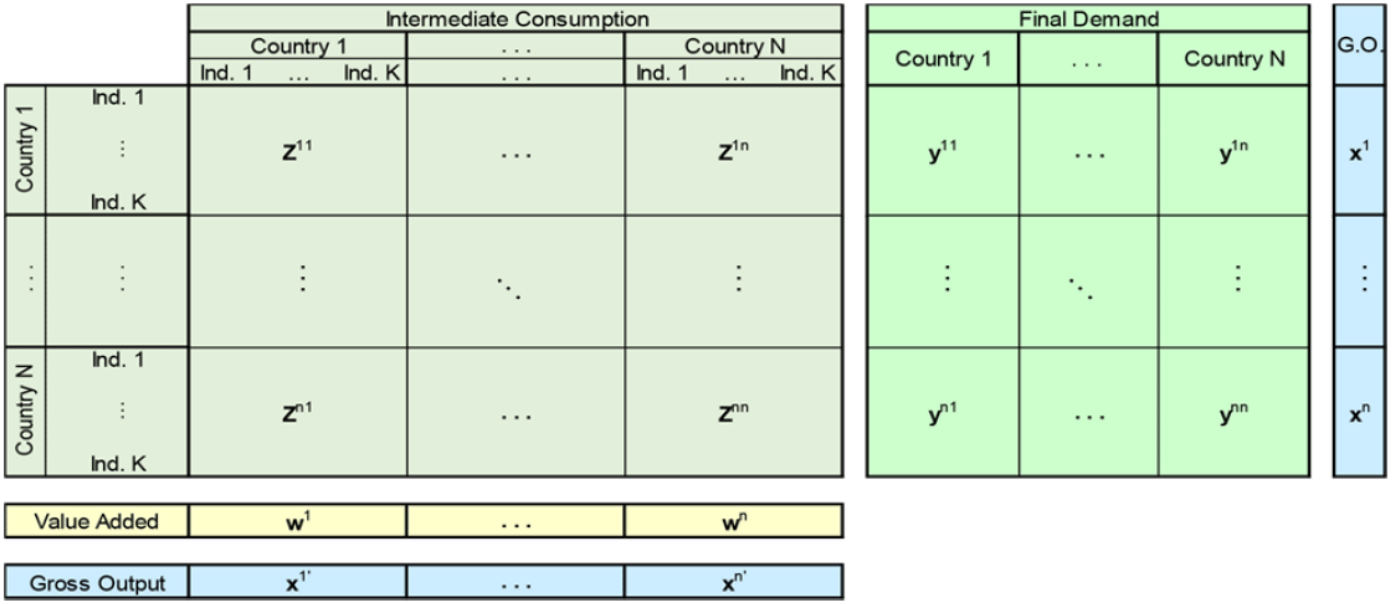


Figure 5. Interregional, multiregional, world tables

- **Hypothetic Extraction Method**
  - $\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{y}$: current output
  - $\mathbf{x}^* = (\mathbf{I} - \mathbf{A}^*)^{-1}\mathbf{y}^*$: output extracting impacted industries
  - Potential output losses: $\mathbf{x} - \mathbf{x}^*$

1.4 Conceptual framework

Method

- **Net raise of foreign exchange (external exposure)**
  - $\mathbf{NX} = \mathbf{A^M}(I - \mathbf{A})^{-1}\mathbf{EX}$: revenues from exports discounted by direct and indirect imported inputs necessary to produce them
- **Tax revenues (fiscal expusure)**
  - $\mathbf{\Delta T} = \mathbf{t}'(\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} - \mathbf{t}'(\mathbf{I} - \mathbf{A}^*)^{-1}\mathbf{y}^*$: tax revenues from production, wages and income, including indirect ones
- **Wages and employment (socioeconomic exposure)**
  - $\mathbf{\Delta W} = \mathbf{w}'(\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} - \mathbf{w}'(\mathbf{I} - \mathbf{A}^*)^{-1}\mathbf{y}^*$: wage bill, including indirect
  - $\mathbf{\Delta N} = \mathbf{n}'(\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} - \mathbf{n}'(\mathbf{I} - \mathbf{A}^*)^{-1}\mathbf{y}^*$: employment, including indirect

2.1 Results
External and fiscal exposure

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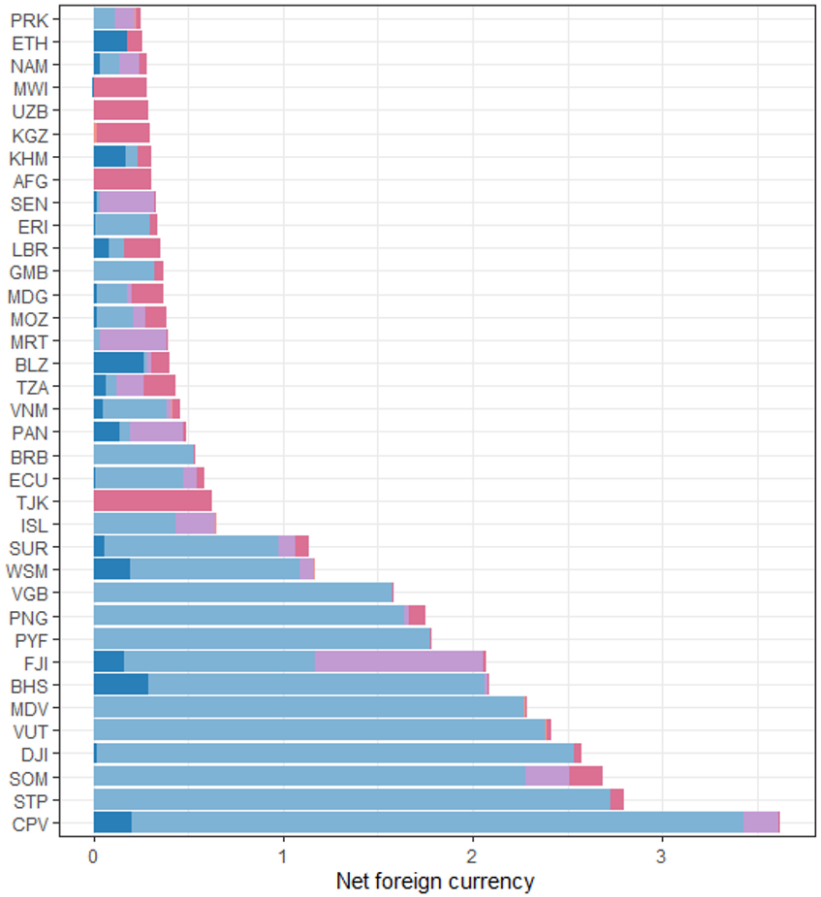

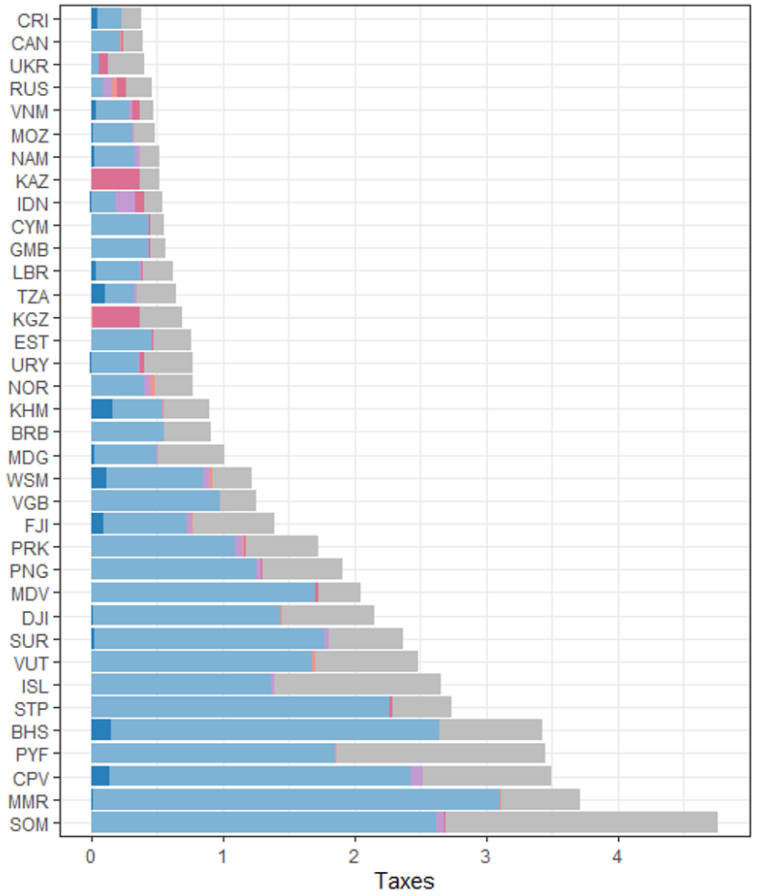

2.2 Results
Socioeconomic exposure

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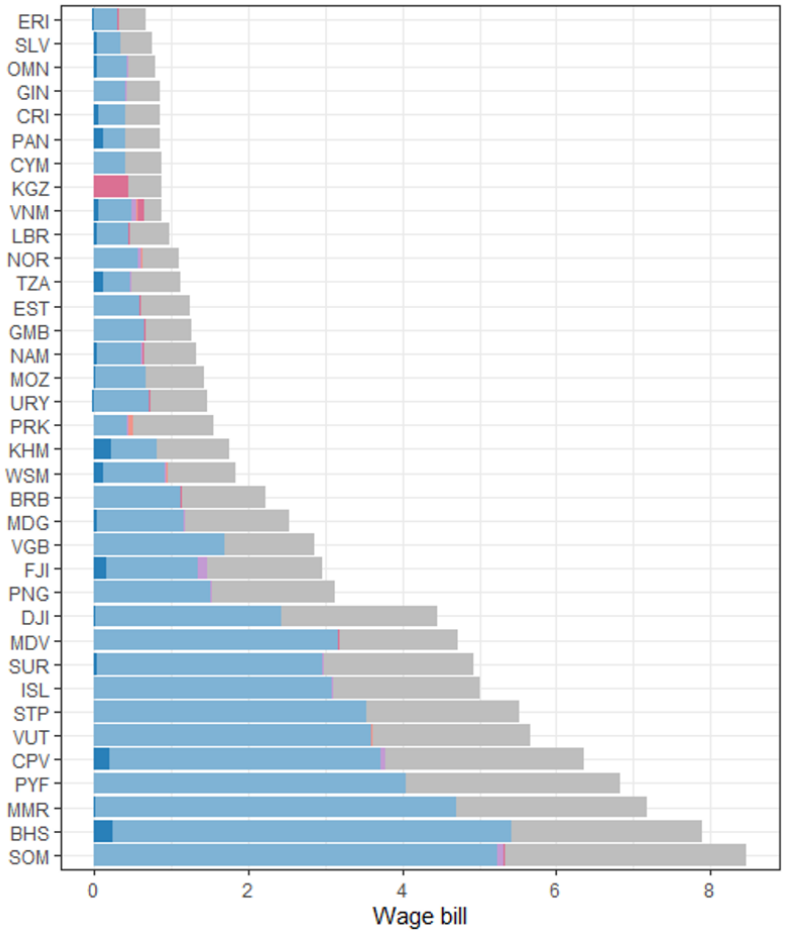

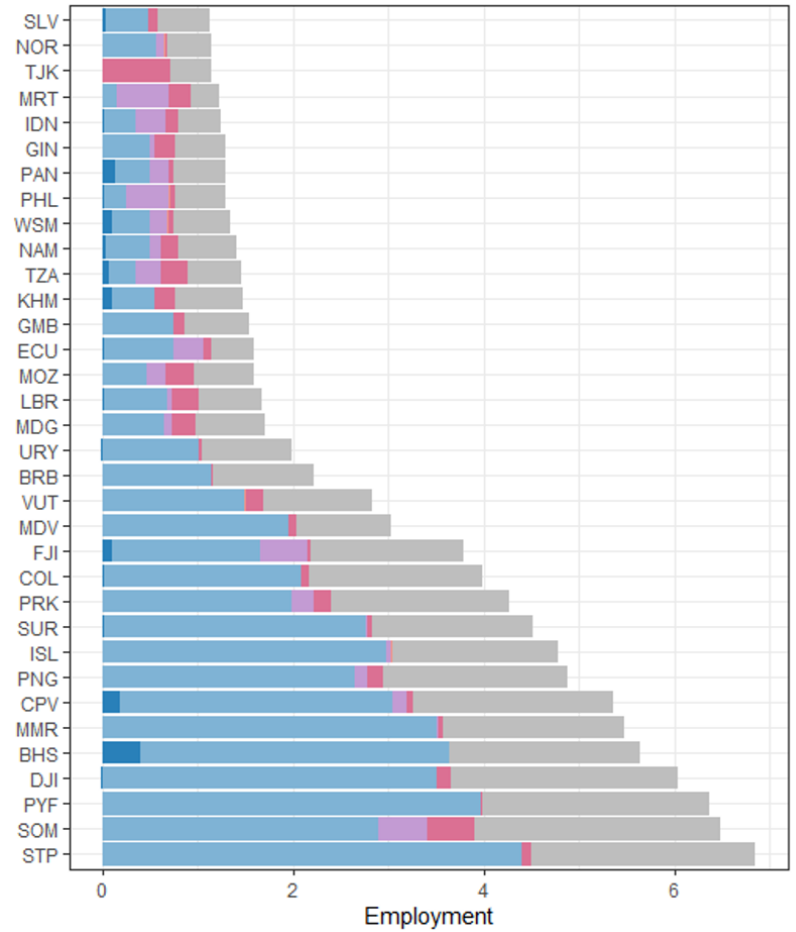

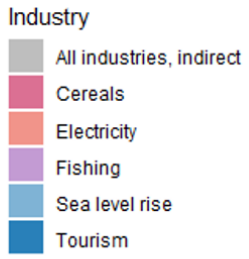

3.1 Discussion

Drawbacks

- **Damage functions**
  - Absence of data for impacts on agriculture other than cereals; impacts are not very relevant at this point as it is expected to be
  - Other sources of sectoral damages that are not included caused by disasters
  - Sea-level rise: sectors with high vulnerable capital tends to be more impacted, but it is not being considered

- **Propagation**
  - Not accounting for forward impacts of price increase: damage impacts may increase prices leading to low competitiveness of downstream activities (Ghosh vs. Leontief models)
  - Price increase, if production becomes non-competitive, will also lead to higher impacts on upstream productive chains

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REMERCIEMENTS

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