From direct to final economic impacts of climate change: The case of heat stress on labour productivity

(preliminary results)

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Motivation

- Heterogeneous biophysical impacts of climate change, hit the poorest regions the hardest (Byers et al., 2018; Arnell et al., 2019)
- How does this heterogeneity translate in terms of economic losses?
- Differences in sectoral/regional biophysical exposure may not translate into proportional economic lossses

Motivation

- Sectors may be vulnerable to impacts elsewhere..
  - reliance on intermediate goods from other sectors, weather shocks propagating across borders along the supply chain (Otto et al., 2017; Henriet et al., 2012), competition for inputs
- ... But economies may adjust through structural change
  - demand reduction, specialization in other sectors, efficient production reallocation, e.g., agricultural production (Gouel and Laborde, 2021; Baldos et al., 2019)
- Trade effects are ambiguous
  - least affected regions may be in a better position to export to international markets
  - ... but may also suffer from raised importing prices of goods produced in affected regions

Motivation

- We study reductions in labour productivity due to heat stress
  - 1/3 of global workforce employed in sectors exposed to heat stress - agriculture and construction (ILO, 2020) - almost 2/3 in low income countries

- We implement labour productivity losses due to climate change in a general equilibrium model, capturing interactions between regions and sectors

Modelling setup: Imaclim-R World

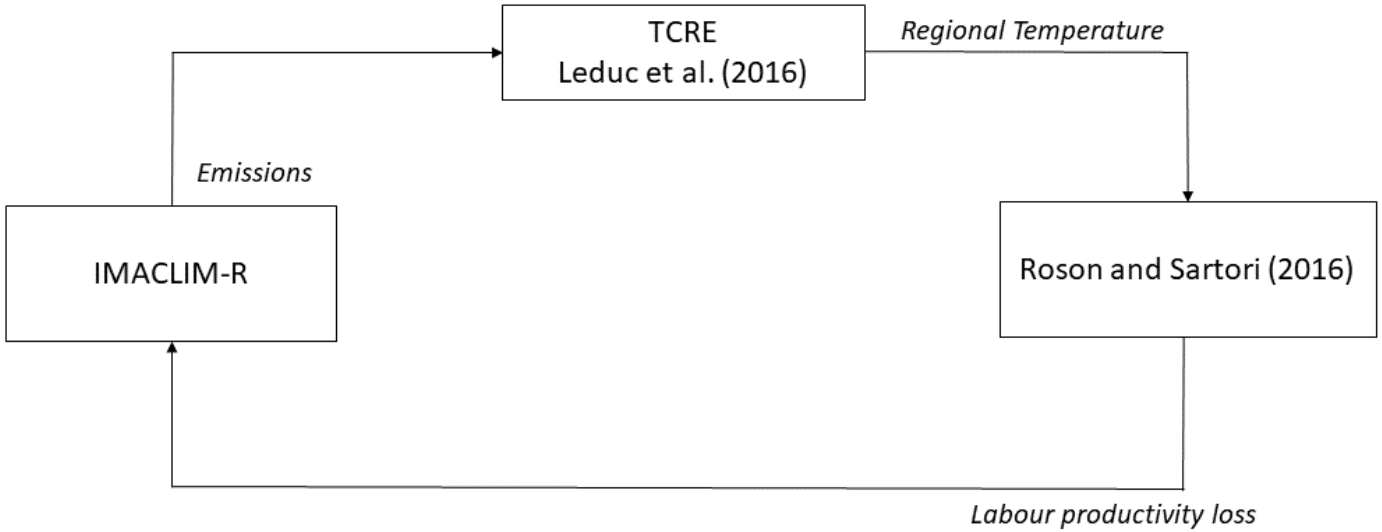
- Global, multi-sector, multi-region, general equilibrium model (Waisman et al., 2012)
- Recursive, simulation model (no intertemporal optimisation)

- Features of particular interest in our case study:
  - international trade: domestic and foreign goods are imperfect substitutes
  - labour markets are not perfectly flexible

Modelling setup: Heat stress impact module

- CO2 emissions converted to regional temperature changes, assuming a linear response (Leduc et al., 2016), using the Transient Climate Response to cumulative carbon Emissions

- Local warming converted to region and sector- specific labour productivity reductions (Roson & Sartori, 2016)
  - Each sector is assigned a category based on working conditions

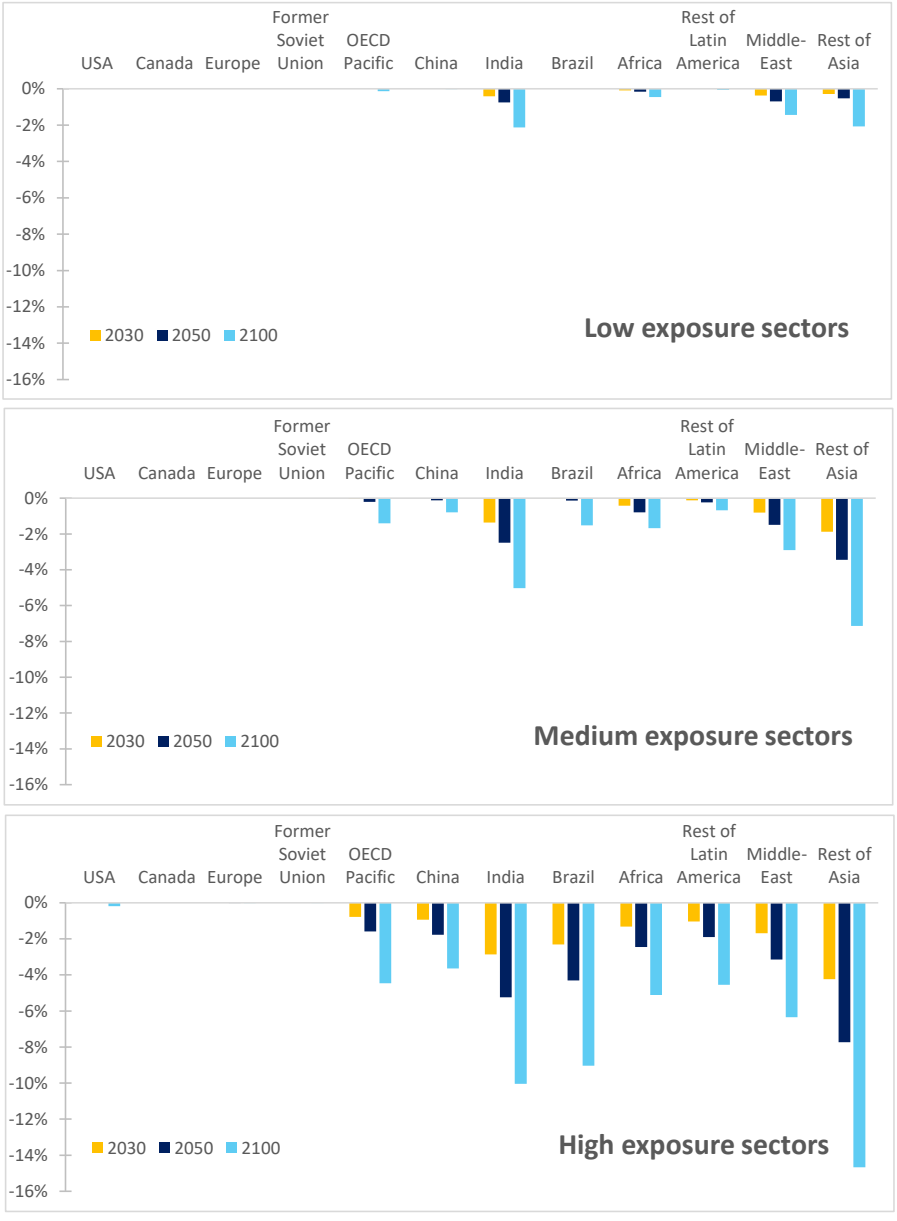


Scenarios

Central scenario

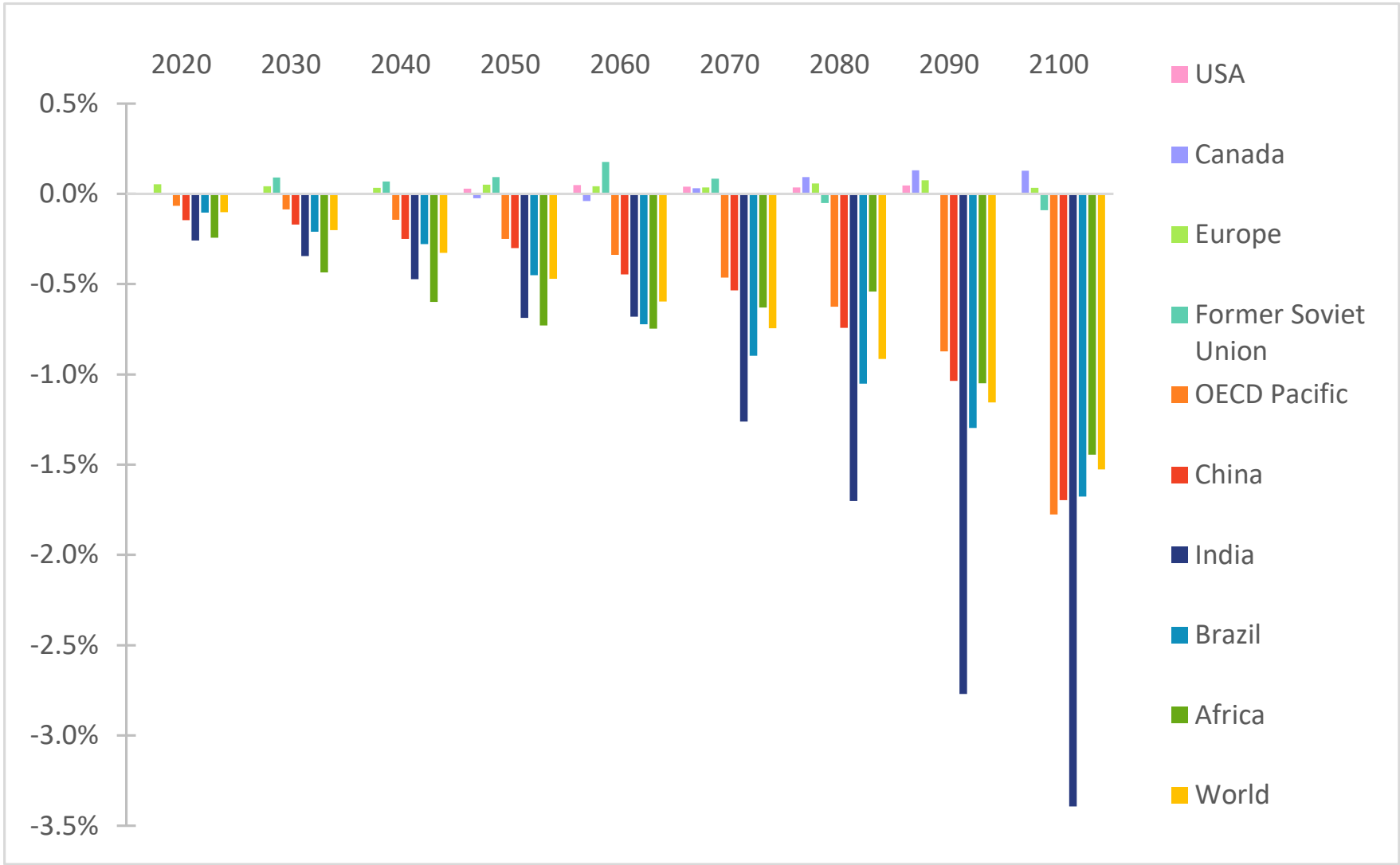
- Baseline consistent with SSP2
- Global temperature rises to 3.8 °C by 2100
- With and without climate impacts

Labour productivity changes across regions and sectors



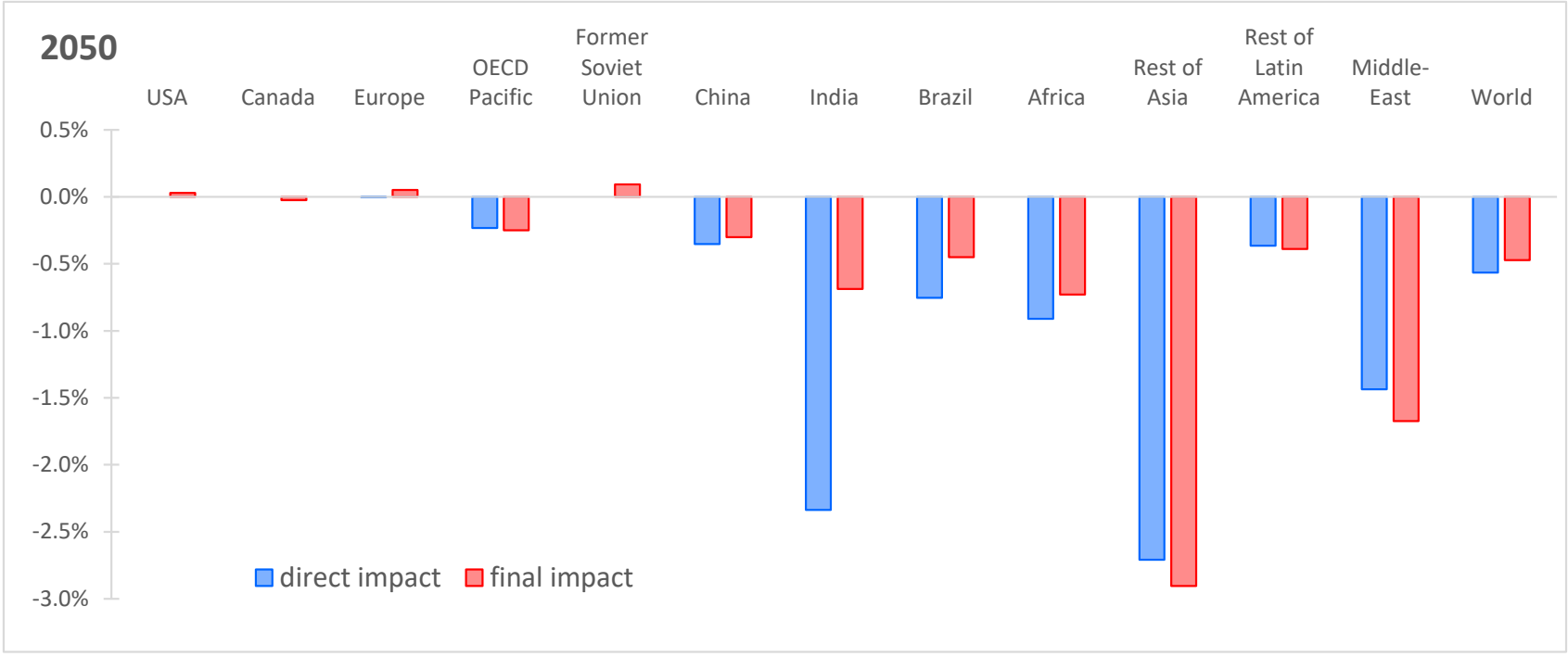
- Heterogeneous productivity losses across regions and sectors
- US, Canada, Europe, FSU little exposed
- India and rest of Asia are the most exposed regions

Economic losses are significant, heterogeneous, increasing



Change in GDP (MER, real) between scenarios with and without impacts (%)

Direct vs. final impact



Change in GDP (MER, real) between scenarios with and without impacts (%)

Conclusion and further work

Significant impact at the global level, heterogeneous impacts across regions

- global GDP losses reach 1.5% by 2100 (SSP2, 3.8 °C)
- US, Canada, Europe, FSU may slightly gain; other regions lose

Direct vs. Final impacts

- Final impacts appear lower than direct impacts at the global level
- Assessment of economic damages based on enumeration of sectoral/regional damages may not be accurate

Further analysis required to explain the distribution of impacts

- Sensitivity analysis on terms of trade, rigidity of labour markets
- Sectoral analysis