Carbon prices and non-climate goals in models with heterogeneous agents

October 7, 2019

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  our models more often than not "presume these other dimensions to be dealt with optimally"
- It is well known that if some optimality conditions don't hold it is not efficient, let alone optimal, to insist that all other variables be at the unconstrained optimum

First best policy

There are good reasons to privilege such an approach.

- Often other dimensions can be taken to be approximately optimal
- Often another institution/branch of government is in the process of bringing the other dimensions closer to optimality
- Even if neither of the above are true treating every public policy issue holistically is
    a. too complicated
    b. a recipe to get stuck in the status quo

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- So far we have looked at second best carbon prices when
  - damage has sub-regional distributional consequences
  - the absence of international transfers renders a global carbon prices inefficient
  - CO_2 mitigation co-reduces emissions of air pollutants with negative forcing properties (details below)
  - mitigation policy with revenue recycling has distributional consequences (work in progress)

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- Endogenising these emissions and associating their reduction to CO_2 reductions has an important effect on optimal global carbon prices
- The effect depends importantly on what air quality policies are adopted independently of climate policy (on how optimal these are)
- To analyze this in an integrated assessment framework we developed the AIR module

The AIR module

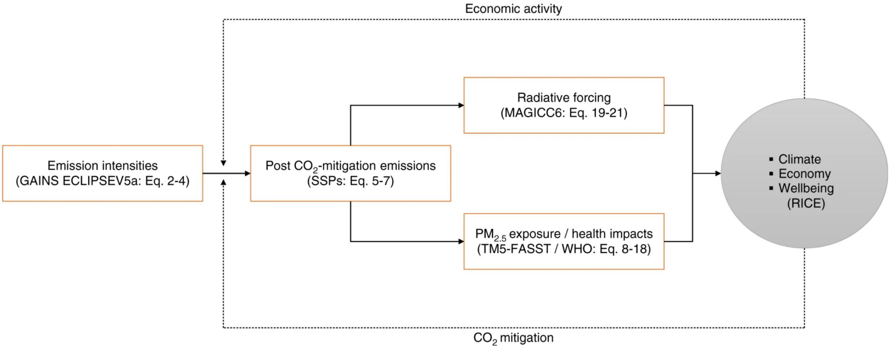

Diagram of AIR module

The AIR module

- Using the ECLIPSE emissions scenarios in the GAINS model we estimate an income-dependent emission intensities for
  - primary PM2.5
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- From this baseline we estimate the extent of co-reduction from carbon mitigation from the SSP scenarios

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- We the $PM_{2.5}$ exposure that results from the computed air pollution emissions using the source receptor matrix from the TM5-FASST model, aggregated up to the model regions
- Combined with exposure-response function and mortality estimates, we can compute the number of life-years gained attributable to reduced air pollution, and monetize this gain with a central VOLY of 2 years of consumption

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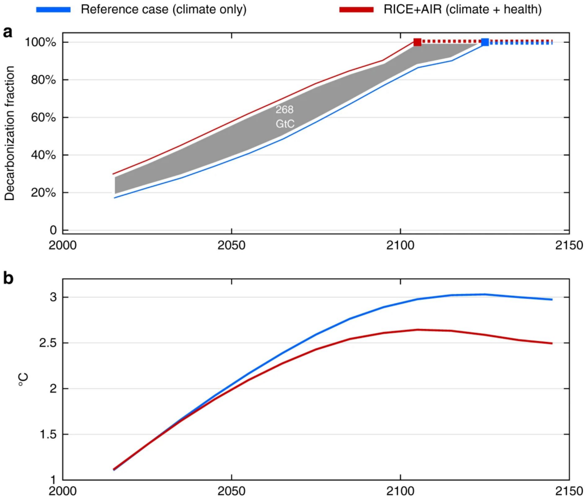
- Combined with exposure-response function and mortality estimates, we can compute the number of life-years gained attributable to reduced air pollution, and monetize this gain with a central VOLY of 2 years of consumption
- We also compute the endogenous change in forcing due to the change in aerosol concentrations using forcing coefficients from the MAGICC climate model and add this to forcing from other GHGs
- These lead to greater temperatures, and thus damages, than if these effects where ignored

Optimal decarbonisation



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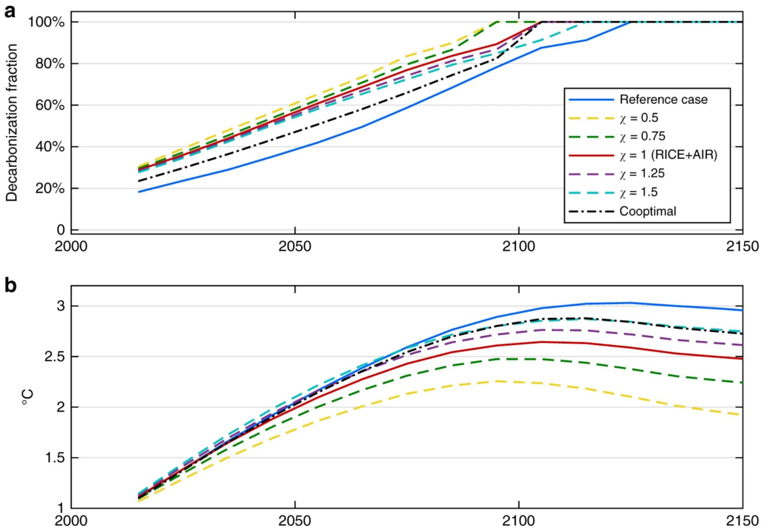
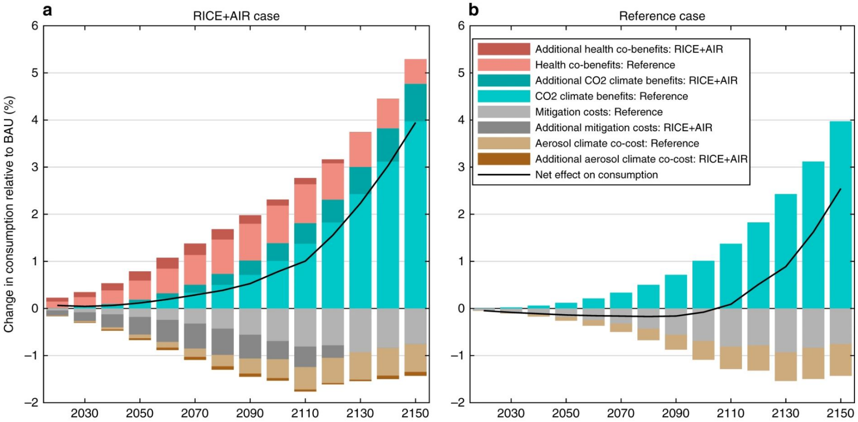
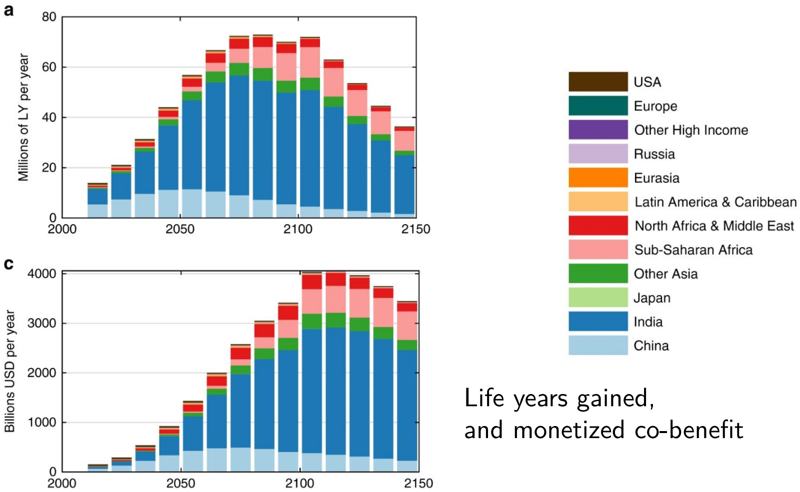


Changes relative to BAU

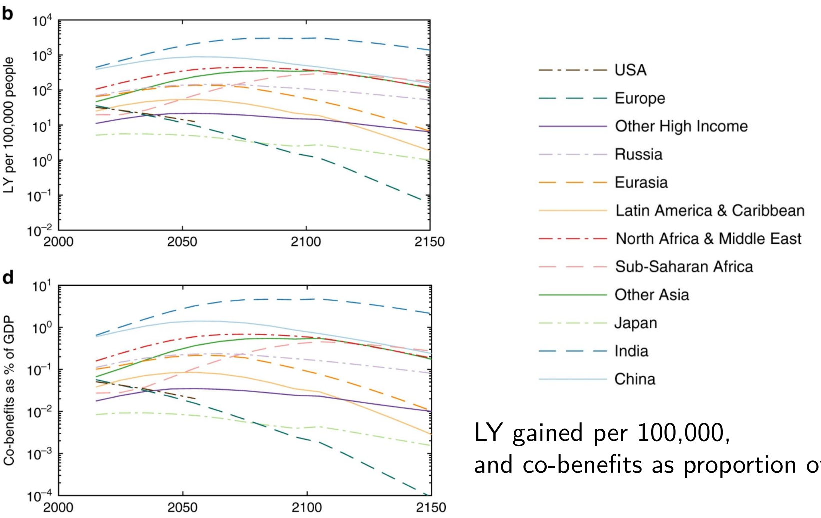


Regional distribution of co-benefits



Life years gained,
and monetized co-benefit

Regional distribution of co-benefits



LY gained per 100,000,
and co-benefits as proportion of GDP

Distribution, first best, and Nordhaus-Yang-Negishi weights

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- When you submit an IAM with any disaggregation in consumption, at least one reviewer always asks about Negishi weights
- What they mean are time-varying (or Nordhaus-Yang) Negishi weights:

$$\omega_{rt} = \frac{\frac{1}{U'(c_{rt})}}{\sum_{j=1}^{R} \frac{1}{U'(c_{jt})}}$$

to be used in the objective

$$W^N = \sum_{t=1}^{T} \sum_{r=1}^{R} L_{rt} \omega_{rt} U(c_{rt}) \beta^t$$

Why they are used in Nordhaus Yang 1996

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- Implementing frictions against these flows without further changes would yield an optimum with regionally different carbon prices.

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- The RICE model calibrates regional differences in productivity
- In the first best this would yield counter-factual cross-regional capital flows
- Implementing frictions against these flows without further changes would yield an optimum with regionally different carbon prices.
- To avoid this Nordhaus and Yang "... *adjust* the Negishi weights across regions for every period." My emphasis

These weights affect time preferences when growth rates are different across regions

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$$W^N = \sum_{r=1}^{R} \sum_{t=1}^{T} L_{rt} \omega_{rt} U(c_{rt}) \beta^t$$

you get

$$s_{rt}^{NYN} \approx \left(\frac{1}{1+\rho - g_{rt} + \overline{g}_t} \right)^{\Delta t} \alpha$$

Greater discounting the future of regions with low growth

- The Nordhaus-Yang-Negishi weights modify the pure rate of time preference (a preference parameter) by inserting technology parameters into it

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- The original weights devised by Negishi do *not* have this feature; it is a (probably unintended and largely unknown) consequence of the time-varying modification.
- It does not seem satisfactory to modify time-preferences just in order to make uniform carbon prices optimal in the face of observed frictions in capital flows

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- Pretending that these frictions don't exist, or to simply model the world by one representative agent is one approach
- Biting the bullet and accepting optimal carbon prices that vary by region is another one
- If one simply can't let go of the uniform carbon price, and still wants to realistically model these frictions, one can simply constrain carbon prices to be uniform in what my colleagues and I have been calling a *third best* approach. This is not ridiculous, I have done it myself.

List of collaborators on these topics

- David Anthoff
- Joshua Bernstein
- Mark Budolfson
- Navroz Dubash
- Frank Errickson
- Johannes Emmerling
- Simon Feindt
- Maddalena Ferranna
- Marc Fleurbaey
- Kevin Kuruc
- David Klenert
- Ulrike Kornek
- Aurélie Méjean
- Wei Peng
- Noah Scovronick
- Robert Socolow
- Dean Spears
- Fabian Wagner
- Stéphane Zuber

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