Epi-Eco Integrated Assessment Modeling

Preliminary!

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Overview

1. Some reflections on the Covid-19 pandemic and the need for Epi-Eco modeling.
2. Our Epi-Eco IAM.
3. Some preliminary results from our model.

The Pandemic

- The largest and most globally synchronized economic shock for as long as we have had national accounts.
- GDP down second quarter by 5-20% relative to previous year in western economies.
  - Sweden 8%, Denmark 8%, Finland 6%, Norway 5%.
  - Germany 11%, France 19%, Italy 18%, Great Britain 22%
  - USA 9%, India 24%, Brazil 11%.
- Also different since we know exactly the reason. Goods and services which requires substantial social contacts in their production or consumption should not be produced or produced in lower quantities and/or in different ways.
- Socially optimal level of GDP is lower. Stimulus policy to undo this is fruitless.

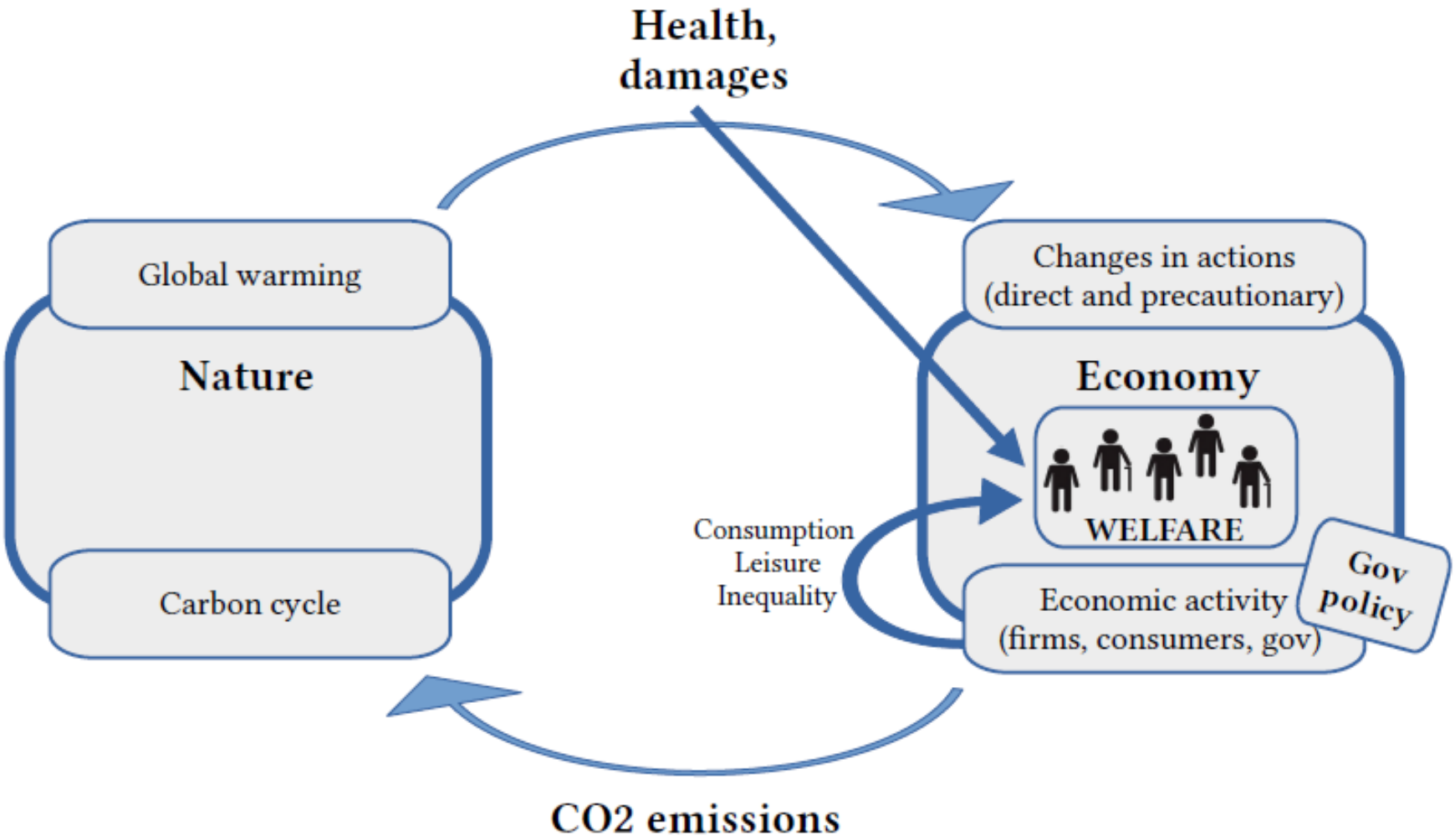
Which economic policy is needed?

- Taking the role of second fiddle, there are three central goals for economic policy during the pandemic:
  1. Short-circuit self-reinforcing feedback mechanisms than can lead to a depression (feedbacks through financial and housing markets particularly dangerous).
  2. Prevent that crisis gives long-term damages to the economy (through e.g., massive bankruptcies and layoffs).
  3. Redistribute the necessary reductions in income in fair way.
- These goals are not generally in conflict with each other during the crisis.
- Most adequate crisis policy (helping failing firms, paying people not to work,...) is bad policy in normal circumstances and should thus be ended when crisis is over.
- So far, the goals have largely been achieved (in Europe) but the crisis is not over. Crisis policy remains important and stimulus is not the right policy (yet).

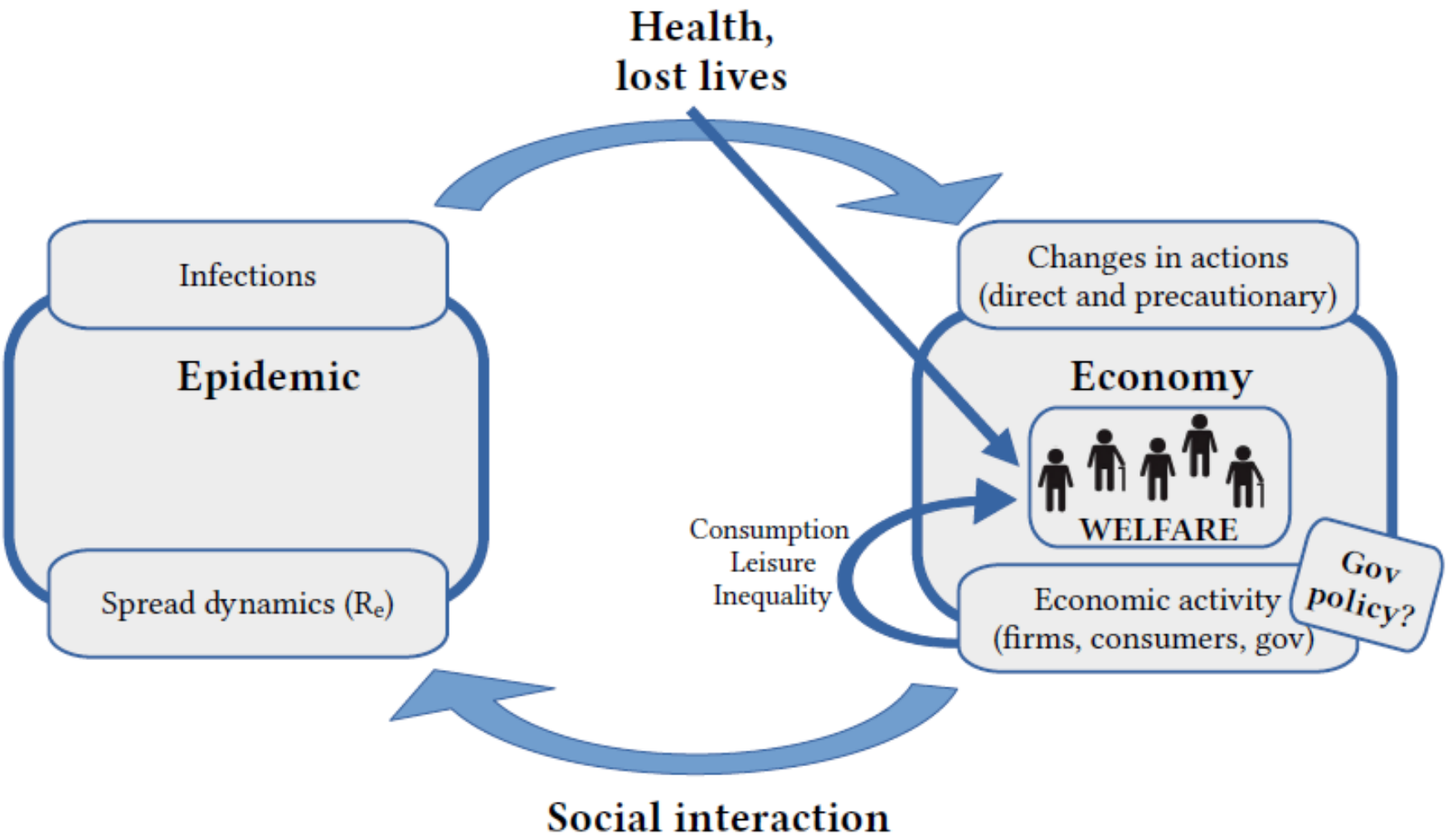
Should economics play second fiddle?

- Statement "health is not traded of against the economy" simply incorrect.
- We need to better evaluate consequences of different pandemic policies – effects on general welfare and its distribution.
- The pandemic and the policies against it affect the economy in dramatic ways,
- but economic activities – in a broad sense – are also key determinants of epidemic dynamics.
- The structure we need: an **integrated assessment model of epidemiology and economics**: an Epi-Eco IAM
  - Describes systematic feedback between the two.
  - Provide possibly better forecasts but arguably more important, allows comparison of different policies, also in welfare terms.
  - Analogous to Clim-Eco IAM.

Clim-Eco IAM


Health,
damages
Global warming
Nature
Carbon cycle
Changes in actions
(direct and precautionary)
Economy
WELFARE
Consumption
Leisure
Inequality
Economic activity
(firms, consumers, gov)
Gov
policy
CO2 emissions

Epi-Eco IAM


Health,
lost lives
Infections
Epidemic
Spread dynamics (R_e)
Changes in actions
(direct and precautionary)
Economy
WELFARE
Consumption
Leisure
Inequality
Economic activity
(firms, consumers, gov)
Gov
policy?
Social interaction

Epi-Eco IAM: theory

- Epi: SIR-like model, in particular detailing
  - extent of interpersonal contacts,
  - other measures taken there (hand-washing, masks,. . .),
  - and heterogeneity.
- Eco: standard plus new focus on
  - households taking into account health consequences of decisions about consumption, work and leisure,
  - voluntary and mandated other precautionary measures against getting infected,
  - and (limited) information and norms.
- **Key: input into Epi has Econ roots, and vice versa**

Epi-Eco IAM: data

- Model – just like climate case – needs to be *quantitative*. Use data to inform parameter choice.
- Eco:
  - standard macro data on consumption, output, wages, etc., but much higher frequency,
  - time allocations,
  - and health data.
- Epi:
  - virus-specific epidemiological facts (R_0, IFR, by subgroup)
- Model parameters selected to match facts like these.
- **Discipline: no degrees of freedom** (every parameter matches a fact).

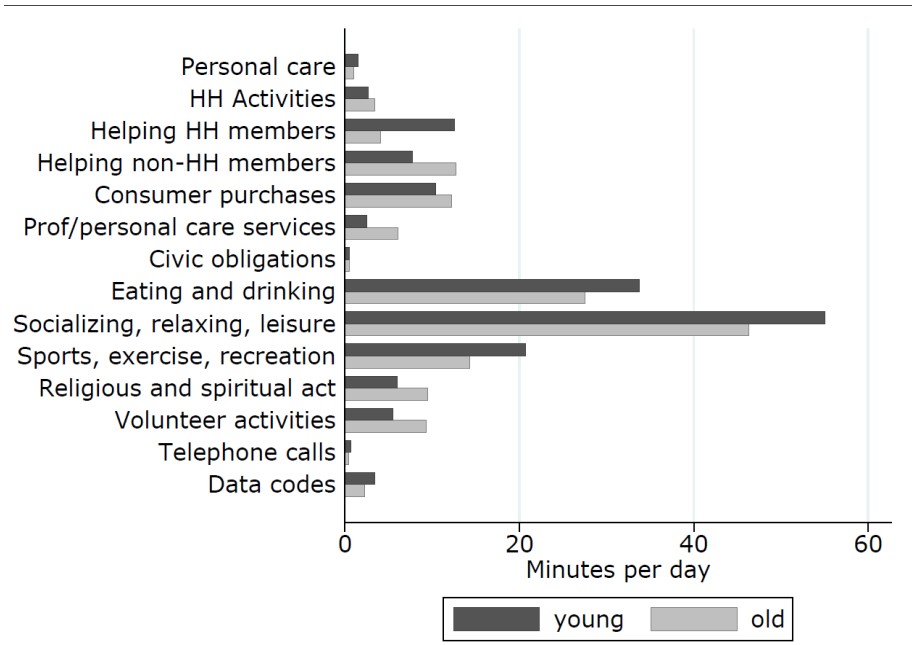
Model is a lab

- Specify a policy (recommendations, restrictions, taxes, transfers, assistance, . . .).
- Solve and simulate: derive output in terms of
  - consumption, health, time use,
  - and more generally life quality,
  - for different people at different points in time.
- Positive, not normative, analysis.
- We can also – but do not need to – calculate "optimal" policy. Then a **social welfare function** needs to be chosen. Specifying how welfare of different people are traded off.

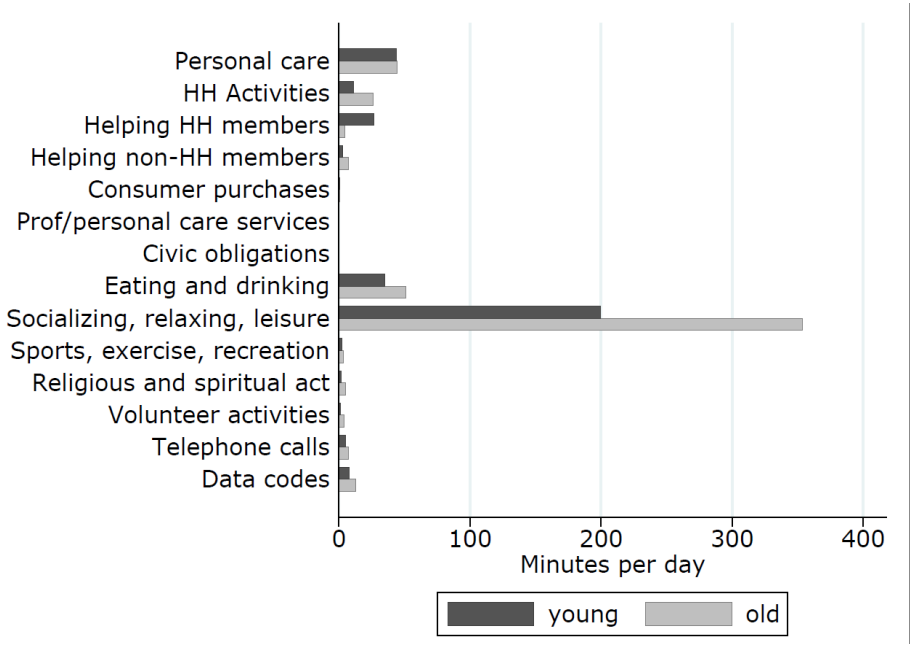
Our Epi-Eco IAM

- Response to what we perceived as missing in early literature:
  - More explicit description of time use in production, consumption and leisure.
  - Consumption is classified as priVate (non-infectious, e.g., watching TV) and puBlic (infectious, going to restaurant). Both requires leisure time use by consumer (and spending).
  - Additionally, time is used for working – at home (non-infectious) or socially (infectious), in the production of the priVate or puBlic good.
  - The different uses of time are imperfect substitutes. Policy and precautionary motive affects time use and thereby how much is produced/consumed of different goods.
  - Infectious time-use drives epidemic dynamics in Epi-part, which affects precautionary motive in general equilibrium.
  - comparisons across different viruses (SARS, ordinary flu, etc.).
- The model is still stylized. It should be viewed as a proof of concept.

Example data:leisure time use



Public Leisure Time



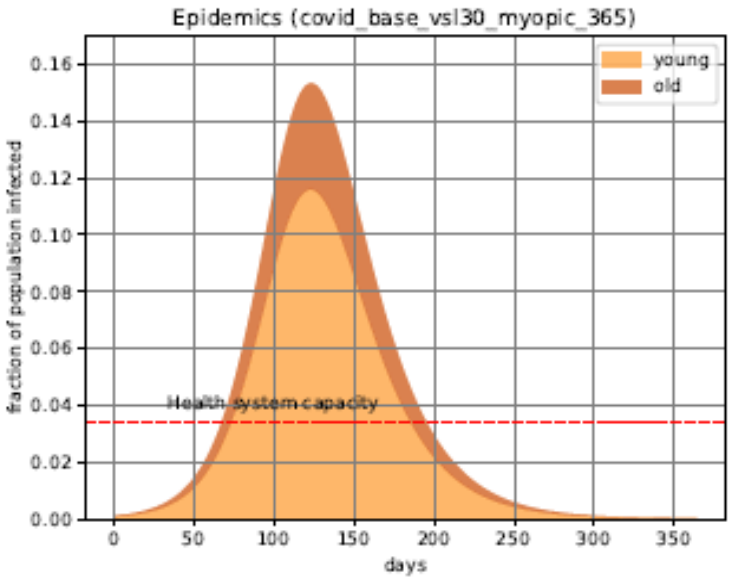
Private Leisure Time

Some results

Compare different scenarios

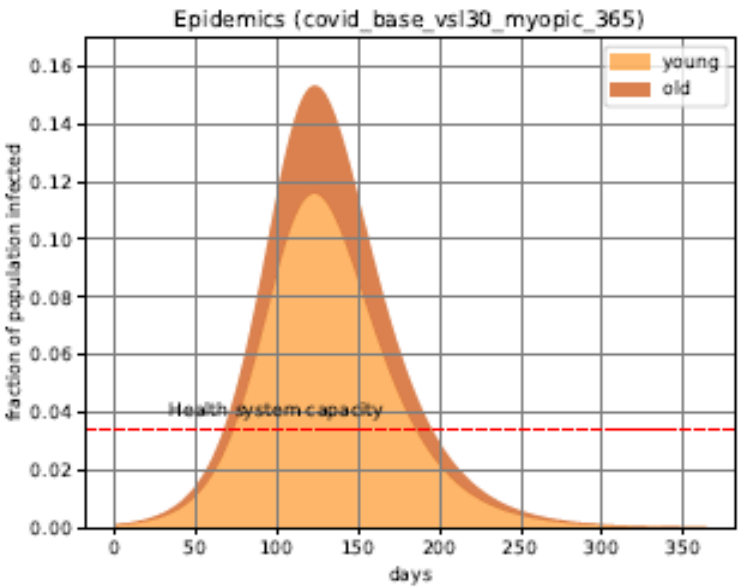
- **Myopic:** Households maximize utility but are unaware of the epidemic – no feedback between epidemics and actions.
- **Full information:** Rational behavior, take into account risk of getting infected and change behavior accordingly.
- **Optimal policy:** Policy introduced that take into account also that people do not fully take into account risk of infecting others.
- Also analyze different assumptions about VSLY, different epidemics,...

Infection dynamics

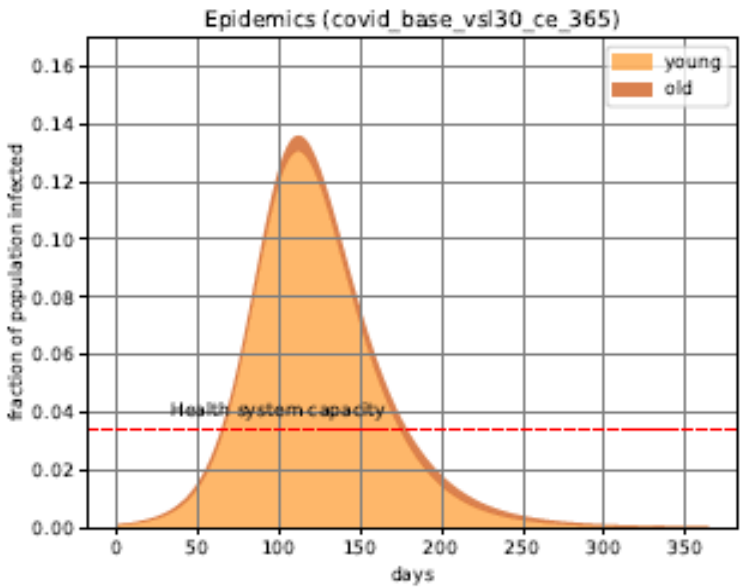


(a) Myopic

Infection dynamics: myopic and full info

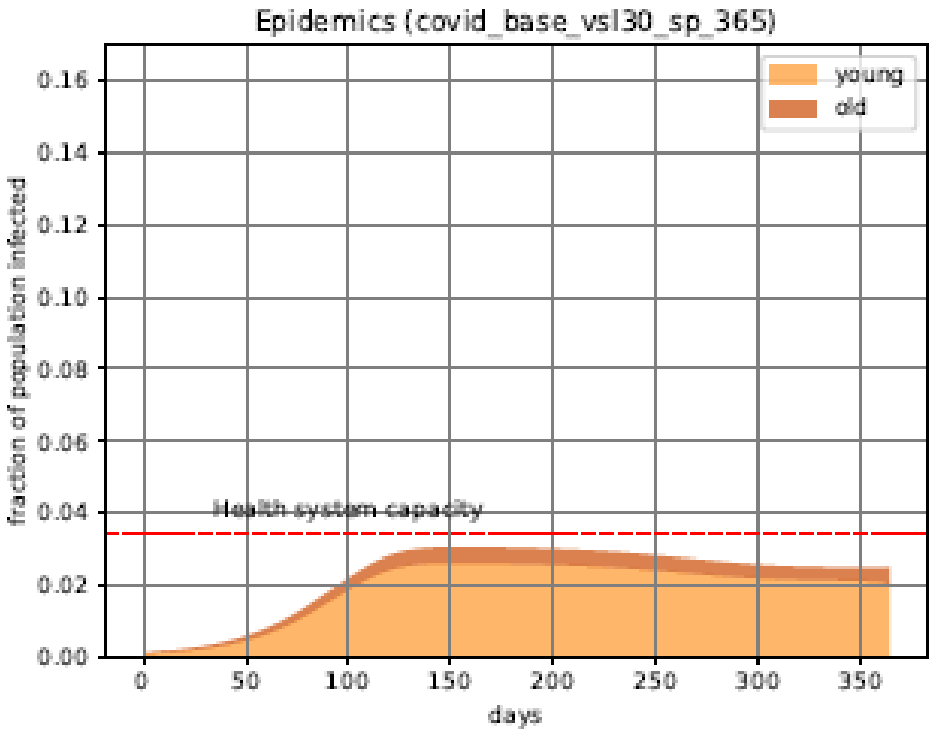


(a) Myopic

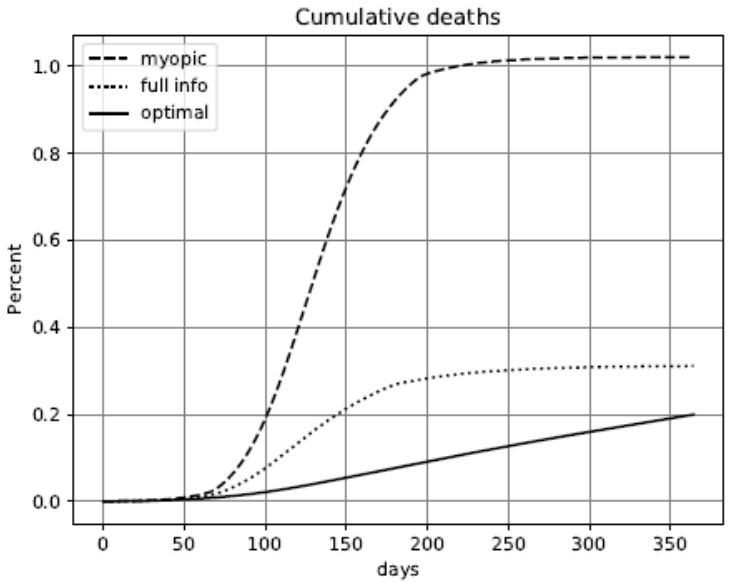


(b) Full information

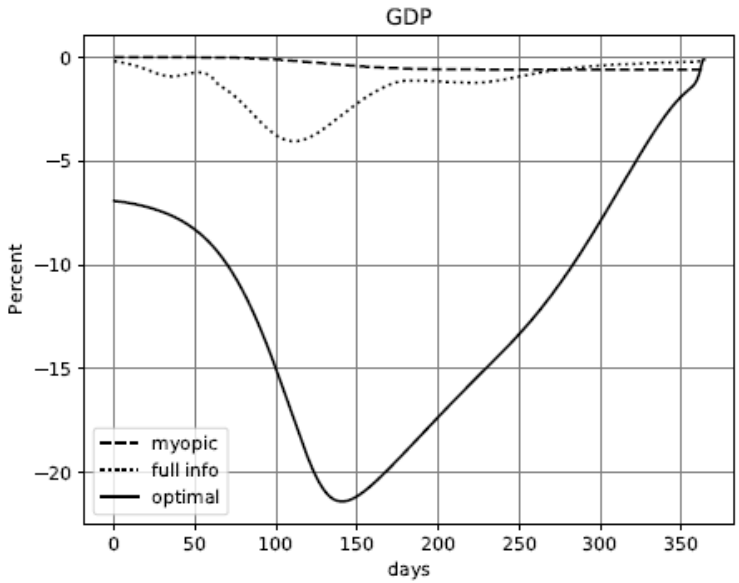
Infection dynamics: optimal policy



Epi-Eco Trade-off



(a) Cumulative deaths



(b) GDP

Conclusion

- Case for using Epi-Eco IAMs as strong for Clim-Eco IAM. Needed for systematic policy evaluation.
- Specifying a model also clarifies what is missing and/or controversial in it.
- More cross-disciplinary work needed.
- We want to:
  - include more heterogeneity in both Eco and Epi parts.
  - include more preventive measures (e.g., hand washing, face masks, etc.)
  - get better estimates of substitutability between public and private time use.
- Should be policy relevant in time for next pandemic.