An Economist's Take on Epidemiology
Biology, Behaviour and Policy

Flavio Toxvaerd

University of Cambridge

June 4, 2020

Background

- Currently facing serious global crisis, with COVID-19 fast spreading across the world
- Crisis threatens our health and livelihoods
- With many infectious diseases, possible to manage through pharmaceutical interventions
  - Antivirals and vaccines not yet available
- Must rely on non-pharmaceutical interventions (NPIs) that induce social distancing
  - Quarantines, self-isolation, school closures etc.

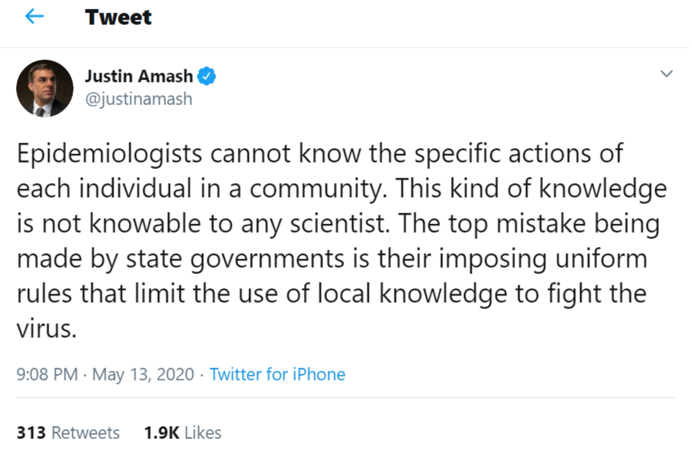
Background

- Note that NPIs are essentially **behavioral interventions**
- What does economics have to do with this?
- Economics is the systematic study of behaviour, guided by incentives, constraints and information
- Alfred Marshall in his Principles of Economics (1890):

"*Economics is a study of mankind in the ordinary business of life...*"

Background

- What we can and cannot know...



Tweet

Justin Amash
@justinamash

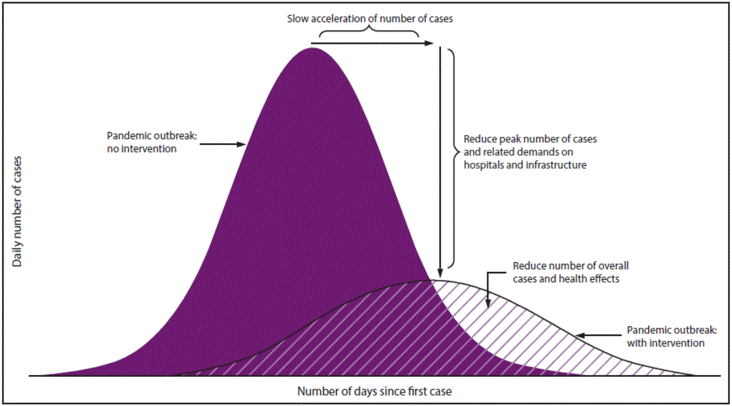
Epidemiologists cannot know the specific actions of each individual in a community. This kind of knowledge is not knowable to any scientist. The top mistake being made by state governments is their imposing uniform rules that limit the use of local knowledge to fight the virus.

9:08 PM · May 13, 2020 · Twitter for iPhone

313 Retweets **1.9K** Likes

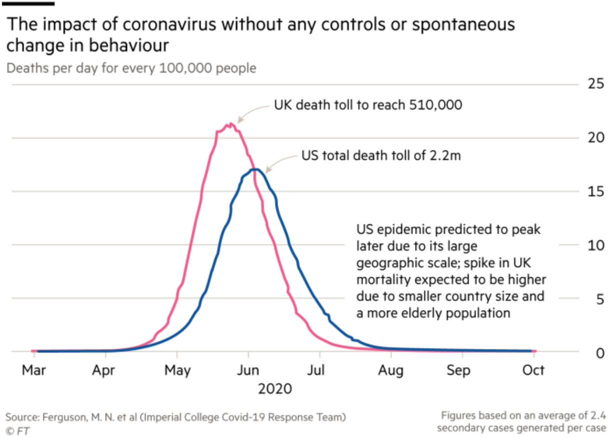
What are we trying to accomplish?

- Flattening the curve:



Policy and the worst case scenario

- Financial Times, March 19, 2020:



Policy and the worst case scenario

- The Guardian, May 29, on February 27 SAGE meeting:

Meeting discusses the "reasonable worst case scenario" in which 80% of the UK population is infected, with a 1% fatality rate – which would mean up to 500,000 deaths, a key move towards eventual lockdown. This was modelling from Prof Neil Ferguson of Imperial College, who was at the meeting.

Policy and the worst case scenario

- Imperial College Report, March 16, 2020:

Results

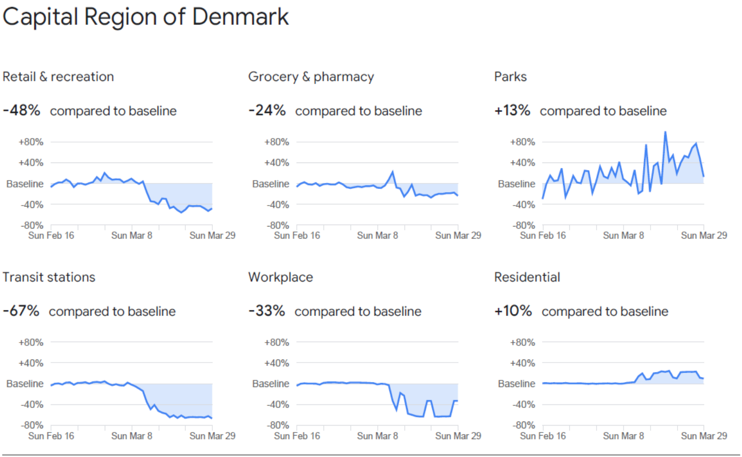
In the (unlikely) absence of any control measures or spontaneous changes in individual behaviour, we would expect a peak in mortality (daily deaths) to occur after approximately 3 months (Figure 1A). In such scenarios, given an estimated R_0 of 2.4, we predict 81% of the GB and US populations would be infected over the course of the epidemic. Epidemic timings are approximate given the limitations of surveillance data in both countries: The epidemic is predicted to be broader in the US than in GB and to peak slightly later. This is due to the larger geographic scale of the US, resulting in more distinct localised epidemics across states (Figure 1B) than seen across GB. The higher peak in mortality in GB is due to the smaller size of the country and its older population compared with the US. In total, in an unmitigated epidemic, we would predict approximately 510,000 deaths in GB and 2.2 million in the US, not accounting for the potential negative effects of health systems being overwhelmed on mortality.

Social distancing...

- The Great Plague of Milan (1639)

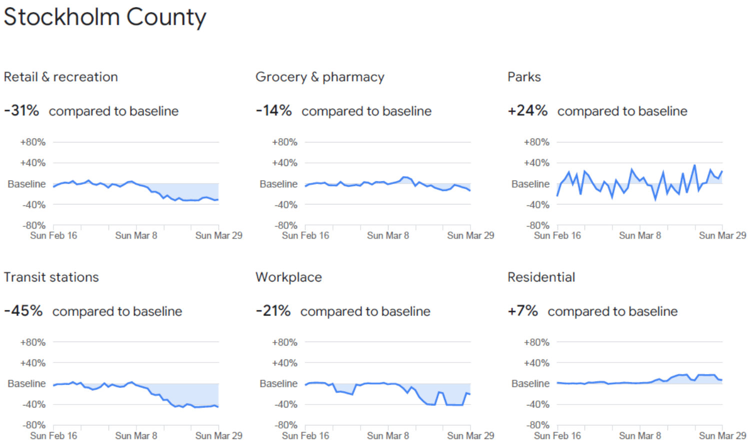
Social distancing...

- Social distancing in modern times:



Social distancing...

- Social distancing in modern times:

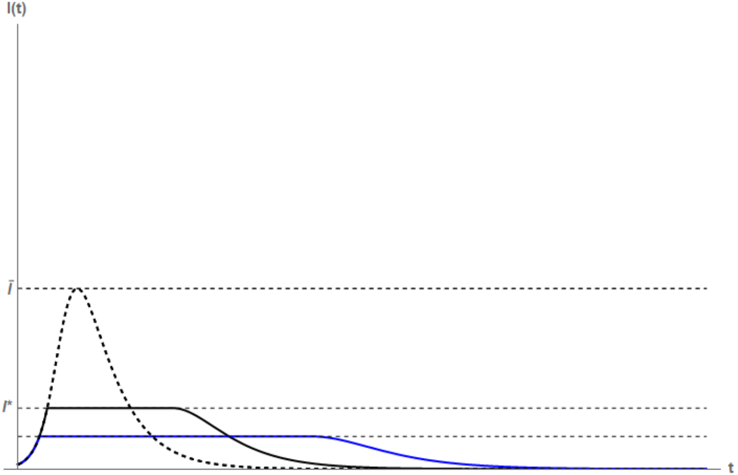


Modelling approach

- Analysis has two components:
- **An epidemiological/biological model** $\rightarrow$ infection and recovery rates
- **An economic model of behavior** $\rightarrow$ preference parameters and feasible strategies to mitigate infection
- By nesting economic model of behavior in epidemiological model of disease dynamics, we can
  - Analyze interplay between individual decisions at micro-level and aggregate evolution of disease at macro-level
  - Can contrast predictions about disease evolution using two different approaches
- Ultimately, better understanding behavior can help formulate better policies for disease control

Introducing behaviour

- How would individuals behave?



The economic model - what we learn

- People will self-protect spontaneously
- Biological do-nothing benchmark not appropriate
- Spontaneous social distancing **not** socially optimal
- There are *positive externalities* from social distancing
  - Too little social distancing in equilibrium
  - Society would prefer more
- How do we achieve this?
- Sticks: fines, social norms etc.
- Carrots: furlough schemes etc.

Going forward

- Better understand the role of asymptomatic infection
- Behavioural consequences of testing
- Effects of population heterogeneity
- Interaction between behaviour and policy