Behavior and the Dynamics of Epidemics

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Lessons after one year of COVID

- Behavior, both public and private, has had a powerful impact on the shape of the COVID pandemic worldwide relative to model predictions without behavior

- \textit{Prevalence-elastic} demand for costly measures to control disease
  - Mitigation efforts rise and fall as current levels of infections and deaths rise and fall

- Impact on equilibrium dynamics of pandemic
  - Short term vs. long term

- Implications for the impact of public health interventions
  - Short term vs. long term
  - Without and with a vaccine or cure

- Why policy has to prepare now for a the possibility of a long haul even with vaccines
Model with no Behavioral Response

1.5 million cumulative deaths

Similar to Imperial College Angela Merkel March 2020

Basic reproduction number $R_0$ determines peak and long run outcome

Model

Data

With behavior but without vaccines

1.27 million cumulative deaths

Seasonality

Pandemic fatigue
In late fall

UK variant in December

Behavior cuts off peak but leads to similar long run outcome

Behavior limits “overshooting” of herd immunity threshold
Implications of prevalence-elastic demand for costly disease control

After short initial phase behavior regulates disease growth like a “cruise control”

But epidemic does not end until Herd Immunity allows a return to pre-pandemic behavior

“Self-limiting” demand for mitigation limits policy options
Extra mitigation without vaccines

Same 1.27 million cumulative deaths

NPI’s like masks, testing, tracing, and isolation, etc.

Deaths delayed but not prevented
Behavior with vaccines

Vaccines start Jan 1 at rate to cover half of population by June 30

Long-run cumulative deaths 672K

Vaccine or cure can limit long run impact

Short run NPI’s now save lives in the long run
Extra mitigation with vaccines

292K cumulative deaths

Delaying deaths with extra mitigation pays off while waiting for vaccine even with private offsetting response
Success stories with mitigation

- Taiwan, South Korea, Japan, Vietnam, Thailand
- Australia and New Zealand
- Finland and Norway
- Uruguay and Mongolia
- University of Illinois Champaign Urbana, Georgia Tech, Clemson
Preparing for an endemic scenario

Model:
immunity lasts on average 18 months
continuous vaccination at current rate

What are our options for continuous disease control?

About 100K deaths/year from a seasonal disease