Discussion of Atkeson and Kissler

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Summary

- Combination of vaccines and behavioral response saved 800k lives compared to no vaccine counter-factual
  - 800k/330M ~ 0.25% of US population
  - H1N1 1918-1919 : 675k/103M ~ 0.65%

- Strong Complementarity
  - unmitigated deaths 3M ~ 1% of population
  - 2/3 vaccinated before first infection
  - Vaccine protects 5x in 2021
Basic Infection Model

- Pop size $N$, $I_t$ infected individuals, $S_t$ susceptible individuals
  \[ I_{t+1} = \beta e_t I_t S_t \frac{S_t}{N} + (1 - \gamma) I_t \]
  $
  \gamma \text{ is recovery rate, } e_t \text{ exposure, } \beta \text{ infection rate.}
  \]

- **Definition: basic reproduction number**
  \[ \mathcal{R} = \sum_{\tau=0}^{\infty} \beta e_0 (1 - \gamma) \tau = \frac{\beta e_0}{\gamma} \]

- Initially $S/N \approx 1$, exponential growth
  \[ \frac{I_{t+1}}{I_t} \approx 1 + \beta e_0 - \gamma \]
Review of SIRD Framework

Susceptible: \( S_{t+1} = S_t - \beta e_t l_t \frac{S_t}{N} - \nu_t \)

Infected: \( I_{t+1} = I_t + \beta e_t l_t \frac{S_t}{N} - \gamma I_t - \delta_t \kappa I_t \)

Recovered: \( R_{t+1} = R_t + \gamma I_t + \nu_t \)

Dead: \( D_{t+1} = D_t + \delta_t \kappa I_t \)

Death rate: \( \delta_t = \bar{\delta} + \exp(\phi I_t) - 1 \)

\( \nu_t \) are the new infections, \( \gamma I_t \) are recoveries, \( \delta_t \kappa I_t \) are sick recoveries, \( \delta_t \kappa I_t \) are sick recoveries.

Death rate: \( \delta_t = \bar{\delta} + \exp(\phi I_t) - 1 \)

\( \bar{\delta} \) is the base death rate, \( \phi I_t \) is the death rate due to congestion.
Results from Jones et al. (2021)

• Trade-off between infection risk and economic activity
  - Mitigate by reducing $C, L$, working from home

• Two key dynamic effects
  - Health care congestion $\bar{\delta} + \exp(\phi l_t) - 1$
  - Learning by doing in remote work
Planning Solution
Results from Jones et al. (2021)

- Trade-off between infection risk and economic activity
  - Mitigation by reducing $C$, working from home saves 0.06% ~ 200k lives

- Compare private and social incentives
  - Private incentives weak (even perverse), back-loaded
Fatalism & Perverse Incentives
Take Away for Future Crises

- Working from home is critical tool
  - Schools, broadband internet

- Externalities and misaligned incentives
  - Congestion: main rationale for govt. intervention
  - Testing: needs to be mandatory

- Mostly aligned incentives
  - Vaccines: Horizon effect helps a lot
  - Early announcement of *plausible* dates
Heterogeneity

- Old vs young
  - Understood. Risk factor 10+

- Across sectors & occupations
  - Understood. Risk factor ~5
Multi-sector Model. Model v Data
Heterogeneity

- Old vs young
  - Understood. Risk factor 10+

- Across sectors & occupations
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- States
  - Not understood. Neither health impact, nor economic impact
  - Factor of 5!
Random? NY vs CA

Cons. (Solid), Labor (Dashed)

Exposure, $e$

Infected, %

Susceptible (LHS), Dead (RHS), %
States

COVID Deaths by State Age Adjusted Rate per 100K (total)

01/01/20 01/01/21 01/01/22 01/01/23 01/01/24 01/01/25

New York and New York City
Texas
California
Florida

COVID Deaths by State Age Adjusted Rate per 100K (total)

01/01/20 01/01/21 01/01/22 01/01/23 01/01/24 01/01/25

West Virginia
Mississippi
New York City
Oklahoma
Utah
Hawaii
Vermont
Oregon
Conclusion


2. Long term mitigation was a surprise? Not sure.
   - WFH and internet.
   - $5 trillion! (Romer 2021)
     - $2T good, $1T dubious, $2T wasted

   - Still 5x. NH, VT ~ Denmark; AZ, MS ~ Russia
   - Really all random?

4. Next time
   - Identify vulnerable populations faster
   - WFH and schools
   - Information structure, test & track
EXTRA: Model

A representative household
- pools infection and consumption risks
- chooses labor supply and work-from-home

Production technology
- Work-from-home ↓ exposure but also ↓ productivity
- Learning-by-doing ↓ productivity losses over time
- Baseline: single-sector

Infection block
- exposure both through consumption and production
- true status (S, I) unobservable
Preferences and Technology

Utility: \[ \sum_{t=0}^{\infty} (1 + \rho)^{-t} u(c_t, l_t; i_t, d_t) \]

where

\[ u(\cdot) = (1 - d_t - \kappa i_t) \left( \log(c_t) - \frac{l_t^{1+\eta}}{1 + \eta} \right) + \kappa i_t (\log(c_t) - u_\kappa) + d_t (-u_d) \]

Effective labor: \[ \hat{l}_t = (1 - d_t - \kappa i_t) \left( l_t - \frac{\chi_t}{2} m_t^2 \right) \]

Cost of working-from-home: \[ \chi_t = \bar{\chi} \left[ 1 - \Delta \chi \left( 1 - e^{-\bar{m}_t} \right) \right] \]

Learning-by-doing: \[ \bar{m}_{t+1} = \bar{m}_t + m_t \]

Exposure: \[ e_t = \bar{e} + e^c c_t C_t + e^l (1 - m_t) (1 - M_t) l_t L_t \]

From shopping From work
Optimality: Private vs Planner

\[ c_t : \quad c_t^{-1} = \lambda_t + 2\lambda_{e,t} e^c c_t \]

\[ l_t : \quad l_t^m = \lambda_t - 2\lambda_{e,t} e^l (1 - m_t)^2 l_t \]

\[ m_t : \quad \lambda_t \chi_t m_t = \frac{\beta V_{\bar{M},t+1}}{1 - d_t - \kappa i_t} + 2\lambda_{e,t} e^l (1 - m_t) l_t^2 \]

\[ V_{it} = -\kappa u_{it} - \kappa \lambda_t \left( l_t - \chi_t m_t^2 \right) + \kappa \frac{l_t^{1+\eta}}{1+\eta} + \lambda_{e,t} \kappa e^l (1 - m_t)^2 l_t^2. \]

\[ - (1 - \gamma) \lambda_{it} - \beta e_t s_t (\lambda_{it} - \lambda_{st}) - \left( \delta_t \kappa + \delta_t' \kappa^2 i_t \right) (\lambda_{dt} - \lambda_{it}) \]
Decentralized Equilibrium

References
Calibration (2021 data)

- Baseline values
  - Recovery rate, $\gamma = 0.35$
  - Base Infection Fatality Rate $\frac{\delta_t \kappa}{\delta_t \kappa + \gamma} = 0.5\%$
  - At $\frac{I}{N} = 0.2$, Infection Fatality Rate $\frac{\delta_t \kappa}{\delta_t \kappa + \gamma} = 1.5\%$
  - Reproduction number (at $e_t = 1$) $R_0 = \frac{\beta}{\gamma + \delta_t \kappa} = 3.3$

- Considerable uncertainty (heterogeneity?)