Discussion of Macroeconomic Outcomes and COVID-19
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Rich Dynamics of Activity and COVID Deaths

Figure 8a. Trend in mobility as measured through smartphone app use compared to January 2020 baseline

Decline and recovery of mobility

Various patterns of new deaths per million
What is the trade-off between COVID mitigation and the economy?

Figure 1: Summary of the Trade-off Evidence

GDP LOSS

<table>
<thead>
<tr>
<th>COVID DEATHS</th>
<th>California [lucky? too tight?]</th>
<th>New York City Lombardy United Kingdom Madrid [unlucky? bad policy?]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany, Norway Japan, S. Korea China, Taiwan Kentucky, Montana [lucky? good policy?]</td>
<td>Sweden [unlucky? too loose?]</td>
<td></td>
</tr>
</tbody>
</table>
What is driving the data?

- Behavioral SIRD model (Violante 2020)
  - Intrinsic differences in transmission rate across locations
  - Regional differences in elasticity of response of activity to infections
  - Interpretations for “luck” and “policy”
  - Consistent with key facts about COVID worldwide
    - Atkeson, Kopecky and Zha (2020)
      - Initially high and highly dispersed $R_0$ across regions
      - Rapid fall in $R_t$ and transmission rates everywhere
Behavioral SIRD model

SIRD model equations

\[ \dot{S}_i(t) = -\beta_i(t)S_i(t)I_i(t) \]
\[ \dot{I}_i(t) = \left[\beta_i(t)S_i(t) - \gamma\right]I_i(t) \]
\[ \dot{R}_i(t) = \gamma(1 - \nu)I_i(t) \]
\[ \dot{D}_i(t) = \gamma\nu I_i(t) \]

Behavioral equations

Transmission rate increases with activity

\[ \beta_i(t) = \bar{\beta}_iY_i(t)^\alpha \]

Regional differences in transmission given the level of activity

Activity decreases with infections

\[ Y_i(t) = \exp(-\sigma_i I_i(t)) \]

Regional differences in how strongly activity responds to infections

\[ \gamma = 1/5 \]
\[ \nu = 0.005 \]
\[ \alpha = 2 \]
Experiment 1: Differences in transmission given activity

- Activity vs Cumulative Deaths
- Daily Deaths
- The effective reproduction number
- Activity vs Cumulative Deaths
Luck: more cumulative deaths goes with more cumulative lost activity

\[ \sigma = 25 \]

\[ R_0 = \frac{\bar{\beta}}{\gamma} = 4 \]

\[ R_0 = \frac{\bar{\beta}}{\gamma} = 3 \]

\[ R_0 = \frac{\bar{\beta}}{\gamma} = 2 \]
Experiment 2: Differences in elasticity of activity
More cumulative deaths goes with less cumulative lost activity

\[ R_0 = \frac{\bar{\beta}}{\gamma} = 3 \]
3. Cumulative Deaths and Cumulative Economic Loss

This section shows the empirical versions of the trade-off graphs for various countries and U.S. states using GDP and unemployment as measures of the economic outcomes.

3.1 International Evidence

We use GDP data from the OECD (2020) and death data from Johns Hopkins University CSSE (2020) to study the international evidence on COVID-19 deaths and GDP. Figure 5 plots the COVID-19 deaths per million population as of August 24 against the loss in GDP. “GDP Loss” is the cumulative loss in GDP since the start of 2020 (we currently have data from Q1 and Q2) and is annualized. For example, a value of 6 means that the loss since the start of 2020 is equivalent to a six percent loss in annual GDP.

Figure 5: International Covid Deaths and Lost GDP

Note: “GDP Loss” is the cumulative loss in GDP since the start of 2020 and is annualized. For example, a value of 6 means that the loss since the start of 2020 is as if the economy lost six percent of its annual GDP.
Disentangling luck and policy

Sweden: High basic reproduction number (unlucky) and relatively slow response (policy)
Differences in transmission and elasticity of response of activity to infections

Log Cumulative Deaths vs Log Cumulative Activity Loss

- UK? $\bar{\beta} = 3.75, \sigma = 25$
- Germany $\bar{\beta} = 2.5, \sigma = 25$
- Denmark
- Finland
- Norway? $\bar{\beta} = 3, \sigma = 17.5$
- Sweden?

\[ \bar{\beta} \gamma \]
Conclusions

• Simple comparisons of economic and disease outcomes across countries and regions are not very informative about good versus bad policies

• Luck may well play the most important role

Figure 6: U.S. States: Covid Deaths and the Unemployment Rate

Note: The unemployment rate is from July 2020.