Some macroscopic observations about COVID-19 mortality in Israel

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Why Israel?

• Israel has been like a testbed during the pandemic for several extreme measures
  • Strong lockdowns and social measures
  • Pioneering implementation of sanitary/vaccination pass
  • Monoculture of Pfizer Biontech vaccines until very late in the pandemic
Covid-19 Cases, Vaccinations and Deaths Normalized

COVID-19 Cases, COVID-19 Vaccinations, COVID-19 Deaths
Stringency index, deaths

• Normalized to [0,1]
Vaccination doses, ICU patients

Normalized to [0,1]
## I.I. Overall Signal Correlation

<table>
<thead>
<tr>
<th></th>
<th>COVID-19 cases</th>
<th>COVID-19 deaths</th>
<th>ICU patients</th>
<th>Hospitalized patients</th>
<th>Tests</th>
<th>Vaccinations</th>
<th>Stringency index</th>
<th>Excess mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 cases</td>
<td>1</td>
<td>0.4478</td>
<td>0.3576</td>
<td>0.7418</td>
<td>0.7948</td>
<td>0.05204</td>
<td>-0.05194</td>
<td>0.5294</td>
</tr>
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<td>0.1558</td>
<td>1</td>
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</tbody>
</table>
Overall signal correlations 2021-2022

- Non-surprising positive correlations:
  - Deaths – cases, Deaths – ICU patients
- Surprising positive correlation
  - Deaths – Vaccination
- Surprising null correlation
  - Stringency index – deaths and cases
Some cross correlation analysis
$xcorr(\text{new\_cases\_smoothed}, \text{new\_deaths\_smoothed})$

- lag = -11
- lag = 142
- lag = 356
- lag = 467
\texttt{xcorr(new\_vaccinations\_smoothed, new\_deaths\_smoothed)}

Cross-correlation of COVID-19 Vaccinations and COVID-19 Deaths

\texttt{lag=-3}
\texttt{lag=-367}
\texttt{lag=-180}
\texttt{xcorr(new\_vaccinations\_smoothed, new\_cases\_smoothed)}

Cross-correlation of COVID-19 Vaccinations and COVID-19 Cases

\text{lag=-364}

\text{Lag= -158}

\text{Lag= -15}
Cross-correlation of COVID-19 Vaccinations and COVID-19 ICU patients

\[ \text{xcorr(new\_vaccinations\_smoothed, icu\_patients)} \]

\[ \text{lag=-16} \]
Results from cross-correlation

- Non surprising
  - Cases match/predict deaths after 11 days
- Surprising
  - Vaccination doses match/predict ICU after 16 days
  - Vaccination doses match/predict deaths after 3 days
  - Vaccination doses match/predict cases after 15, 158 days
    - Maximal at 365 days??
Wavelet coherence analysis
observations

• Non surprising long term in phase coherence of hospitalizations and ICU patients with deaths

• For periods below 32 days there is surprisingly little coherence
Observations

- Surprisingly, the long term coherence between cases and deaths is absent.
- In some localized periods of time there is medium term (32 to 64 days) coherence where cases are predicting deaths (up arrow).
- Surprisingly there is little coherence at short term.
Wavelet Coherence of stringency index and deaths
observations

- Long term coherence in phase is detected with low significance
  - In phase: more stringency more deaths
- During most of 2020 and until mid 2021, there is medium term (64 days) coherence where stringency predicts deaths
- In 2022 there is in phase medium term coherence between stringency and deaths
observations

- During 2021 there is long term in phase coherence between vaccine doses and deaths
- In the first quarter of 2021 there is a strong in phase medium term coherence of vaccine doses and deaths
- Around october 2021 there is strong almost in phase short term coherence of vaccine doses and deaths
- At the end of 2022 there is strong almost in phase short term coherence of vaccine doses and deaths
Regressing COVID-19 deaths from the other variables

Variable importances
### Input variables

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>tStat</th>
<th>P-Value</th>
</tr>
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<tbody>
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<td>1.0562e-05</td>
<td>-2.2193</td>
<td>0.0269</td>
</tr>
</tbody>
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### Variables

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<td>-0.0594</td>
<td>0.0268</td>
<td>-2.2193</td>
<td>0.0269</td>
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Normalized to \([0,1]\)
observations

- Main effect comes from the hospitalized patients
- Stringency index has a positive coefficient highly significant ($p<0.005$)
- Vaccination doses has a minor negative effect with low significance ($p=0.02$)
Input variables:
• Cases t0-t31
• Deaths t1-t31
• ICU patients t0-t31
• Hospitalized patients t0-t31
• Tests t0-t31
• Vaccinations t0-t31
• Stringency index t0-t31
observations

• Importance == 1 – p-value
• Past values of death and cases series have a large effect,
• Vaccination doses appear among the most salient variables
Prediction of covid-19 deaths by random forest regression
<table>
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<tbody>
<tr>
<td>ICU patients</td>
<td>2.6699</td>
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<tr>
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<tr>
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Normalizing data

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<td>ICU patients</td>
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<td>vaccinations</td>
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<tr>
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<tr>
<td>tests</td>
<td>6.3481e-05</td>
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observations

● Stringency index and vaccine doses appear as more important variables than hospitalizations, cases and tests

● Do not provide the direction of causality
observations

- Past values of stringency index and vaccine doses appear as more important variables than hospitalizations, cases and tests
- Do not provide the direction of causality
COVID mortality versus all cause mortality

- All cause mortality from euromomo.org
- OWD data converted to z-score for joint plotting:
  - comparison is qualitative
- Observations:
  - there is some synchronization of peaks
- BUT
  - There are excess mortality periods unrelated to COVID
II. Euromomo vs OWD zscores

Euromomo Vs. OWD z-scores

Euromomo z-scores

Owd z-scores
Variability of data reported in euromomo accross the pandemic
Data downloaded on 1-March-2022 peak  2022-05 = 9.24
Data downloaded on 1-Apr-2022  peak 2022-05 = 12.04
Data downloaded on 2-Oct-2022  peak 2022-05 = 11,52
Data downloaded on 7-Jun-2023  peak 2022-05 = 8,22
Current plot at 2023-06-16
Evolution of published plots of Israel all cause all ages deaths of Israel

z-score values differences during different downloading dates

- November 2021
- December 2021
- January 2022
- February 2022
- March 2022
- April 2022
- May 2022
- June 2022
- July 2022
- August 2022
- September 2022
- October 022
- November 2022
- December 2022
- January 2023
- February 2023
- March 2023
observations

- Published data can be subjected to unexplained variations
- Trust in official data should be backed with some kind of certification (?)
- Who defines truth?
A perspective over a longer spam of time
Subtracting COVID-19 deaths from all cause deaths
observations

- COVID-19 deaths account for a minimal fraction of all cause deaths
- Removing COVID-19 deaths from all cause deaths
  - Produces an artificial reduction of all cause death profile that reproduced yearly
Causes of death

COVID included in influenza + pneumonmy???
Death Causes

Israel death causes between 2016 and 2020

- Coronary Disease
- Alzheimer/Dementia
- Kidney
- Stroke
- Lung Cancer
- Diabetes Mellitus
- Lung Disease
- Influenza/Pneumonia
- Colon Cancer
- Breast Cancer

Numberofdeathsdetailedcauses?%3Aembed=y&Language%20Desc=English
Concluding remarks
Concluding remarks

- Israel has been portrayed as the show case of Biontech vaccination solution
- The relation of virus control measures (stringency + vaccination) shows some surprises that are not easy to characterize numerically
- There is no reference model of the expected response to control measures
  - I.e. in automobiles we expect the car to stop when we pull the brake
  - However, in COVID-19 after mass vaccination the peaking of omicron cases was strongly correlated stopped with the end of massive testing
A final question

- Imagine that the virus control solution was applied to HIV instead of a coronavirus
- Imagine that the COVID-19 time series of cases is a time series of HIV cases
- Would you repeat all the steps taken to control SARS-CoV-2?
A final question

- In fact, the Bill & Melinda Gates foundation published funding to both Moderna and Biontech prior to 2020 for research on HIV vaccines.