

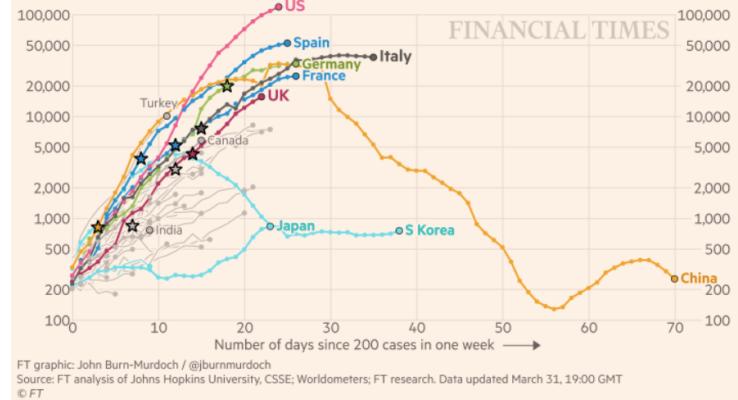
# Coronavirus

## Where we think we are as of Wed Apr 1:

- We really do not know
- No random samples...
- Best thing I have read comes from Jim Stock <<https://drive.google.com/file/d/12MV466ZZy5xHir4xdPhoTrL1oO8CbZU-/view>>:
  - The basic SIR epidemiological model of contagion
  - The effect of social distancing and business shutdowns on epidemic dynamics enters the model through a single parameter: the case transmission rate  $\beta$
  - Re-express the model in terms of  $\beta$  and the asymptomatic (or not very symptomatic) hence non-tested rate—the fraction of the infected who are not tested
  - The COVID-19 non-testing rate is unidentified in our model
  - Estimates in the epidemiological literature range from 0.18 to 0.86.
    - The asymptomatic rate could be estimated accurately and quickly by testing a random sample
- The optimal policy response and its economic consequences hinge critically on the asymptomatic rate

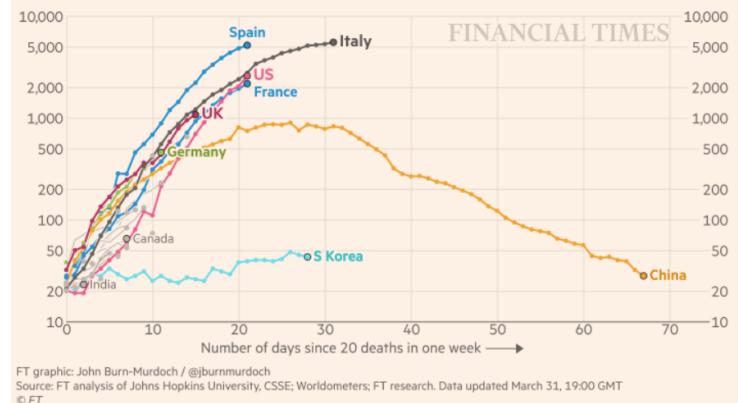
Italy has turned the corner, with numbers of new cases now in decline, following in China's footsteps

New confirmed cases of coronavirus in the past week, by number of days since 200 new cases in one week



Italy's daily death toll is plateauing, but in Spain, the UK and US every day brings more new deaths than the last

New deaths with coronavirus in the past week, by number of days since 20 deaths in one week

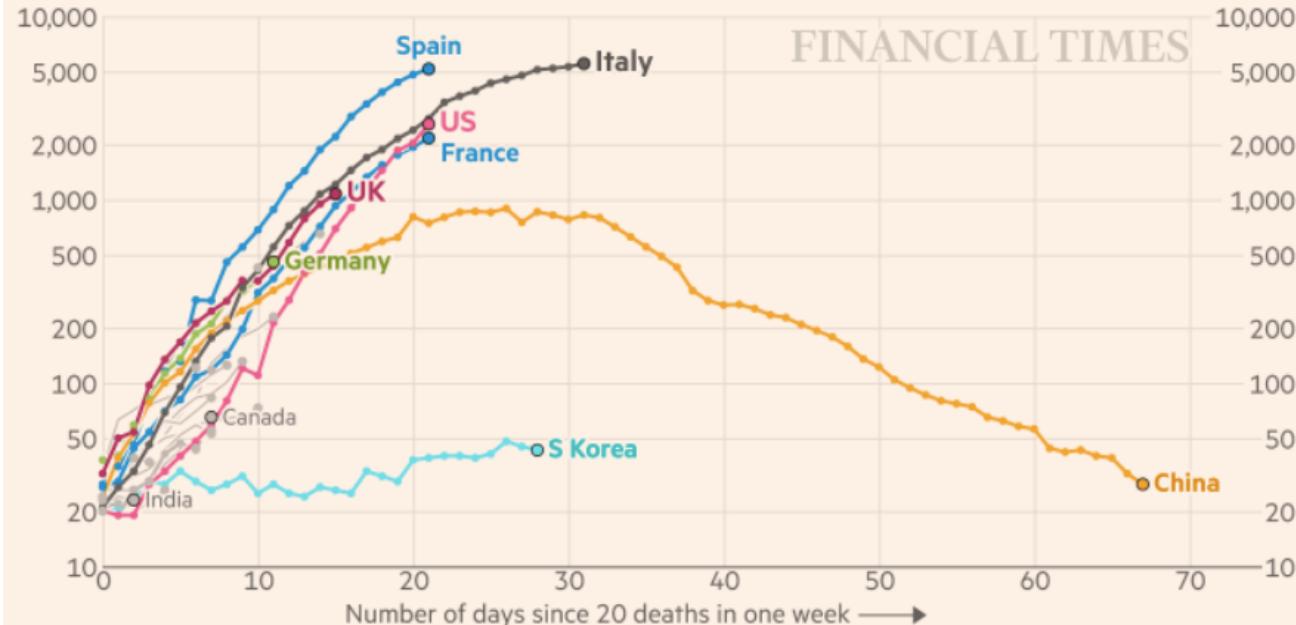


# Financial Times Graphs Blown Up...

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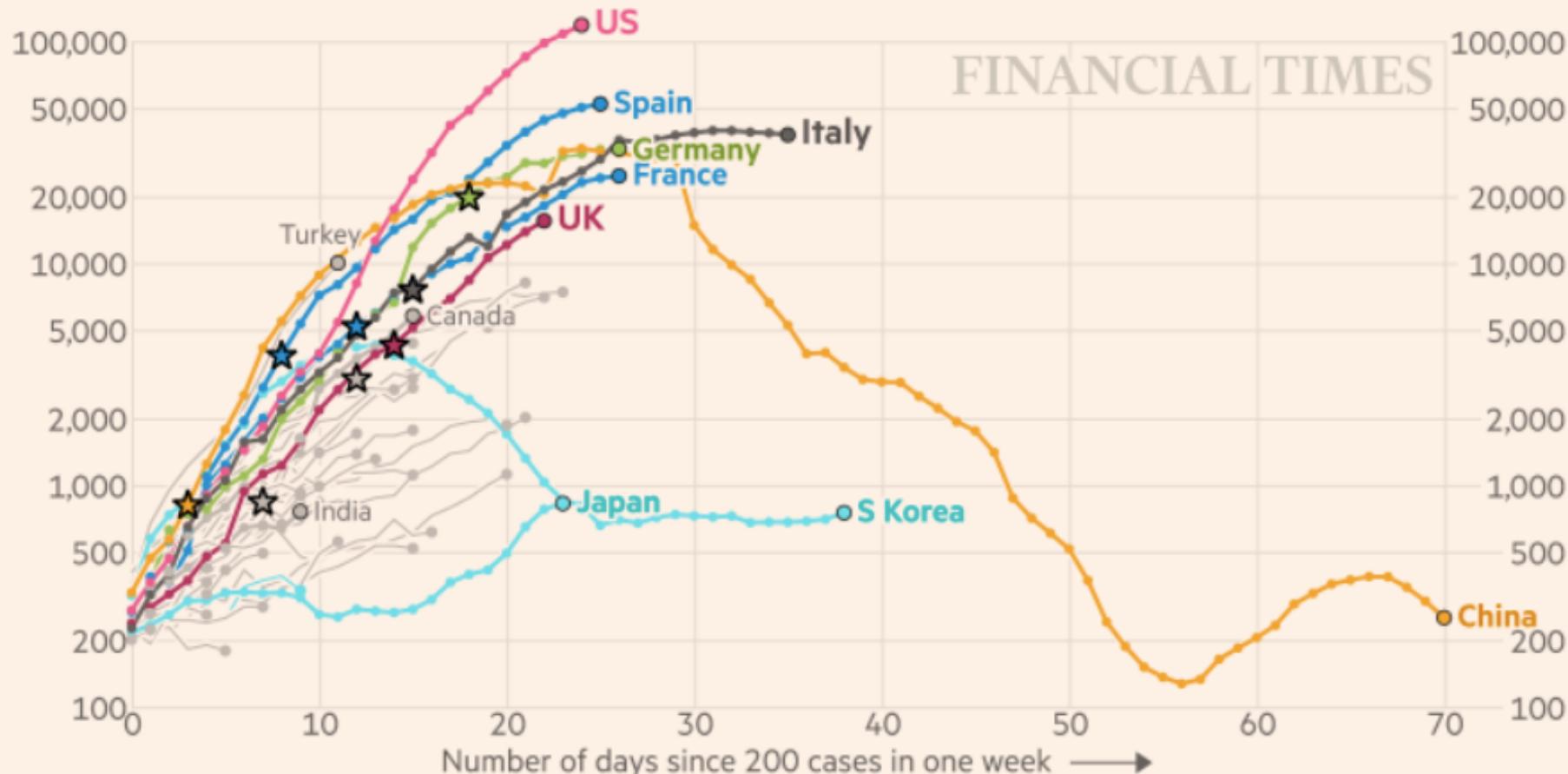
FT graphic: John Burn-Murdoch / @jburnmurdoch

Source: FT analysis of Johns Hopkins University, CSSE; Worldometers; FT research. Data updated March 31, 19:00 GMT

© FT

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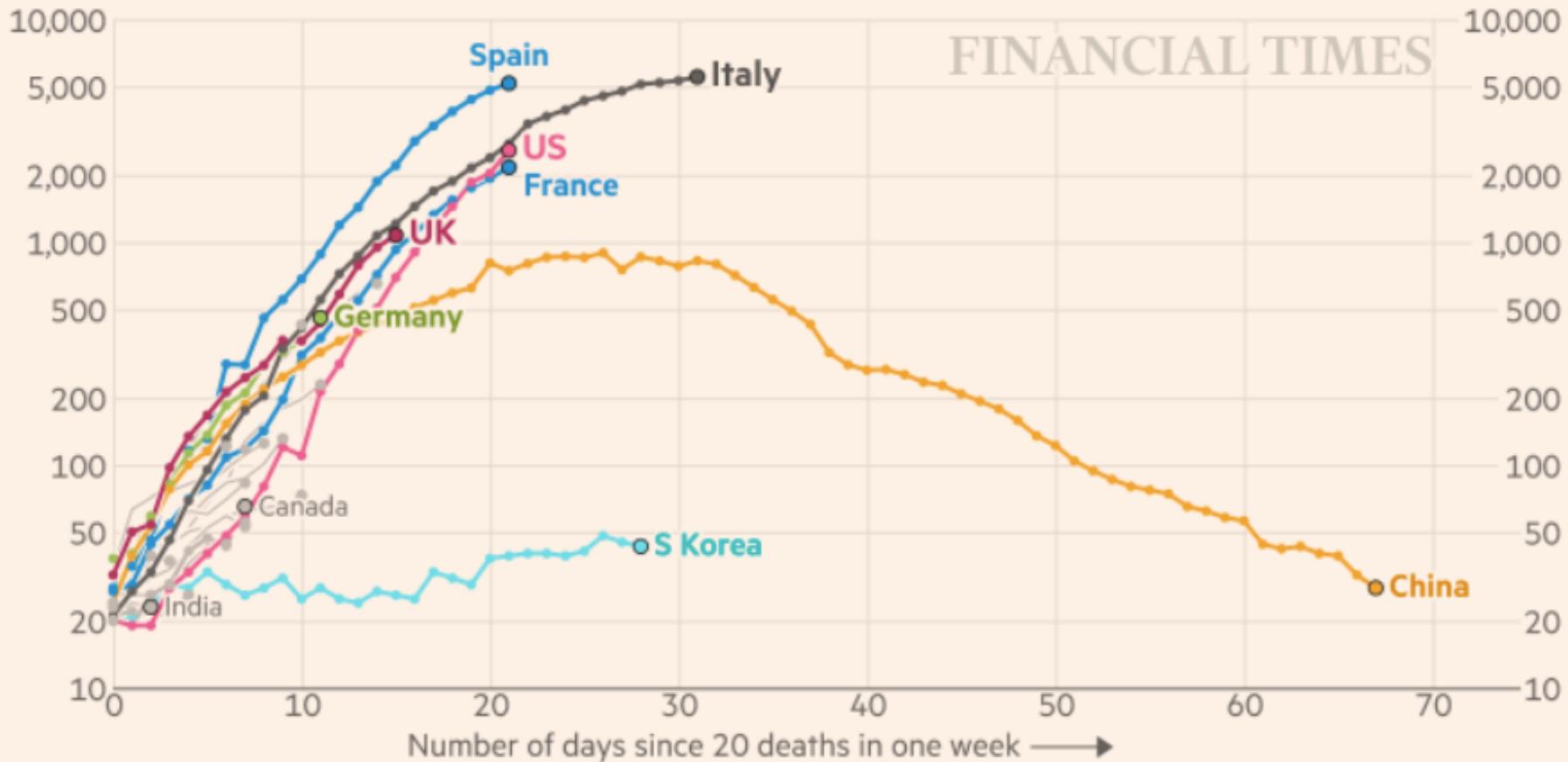
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© FT

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FT graphic: John Burn-Murdoch / @jburnmurdoch

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# James Stock (2020)

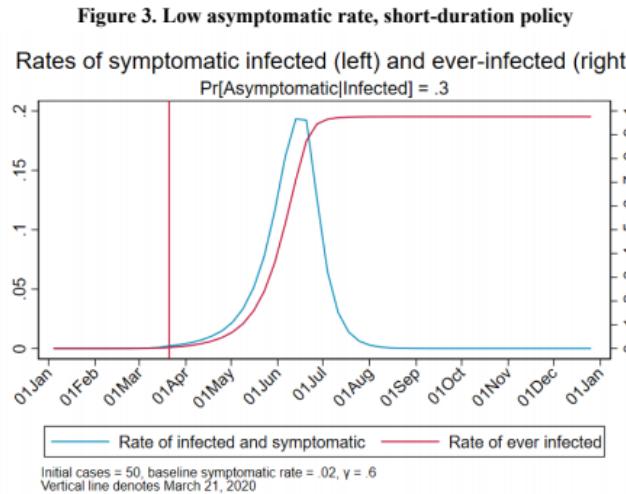
<<https://drive.google.com/file/d/12MV466ZZy5xHir4xdPhoTrL1oO8CbZU-/view>>:

- Susceptible, Infected, Recovered (& immune), transmission rate  $\beta$ , recovery rate  $\gamma$ , reproduction number  $R_0$ , asymptomatic hence non-tested rate  $\pi_0$
- Calibration: half-life of infection one week:  $\gamma = 0.5$ ,  $s_0 = 0.02$ , 50 cases on Jan 24
- For March 21, 2020, the positive test rate in the United States is approximately 10%...

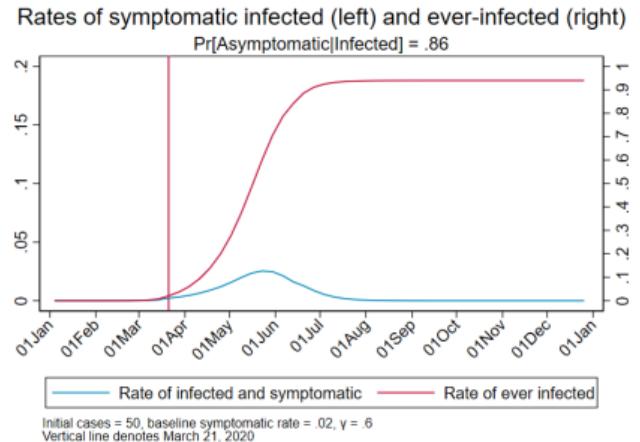
$$\Delta S_t = -\beta I_{t-1} \frac{S_{t-1}}{N}$$

$$\Delta R_t = \gamma I_{t-1},$$

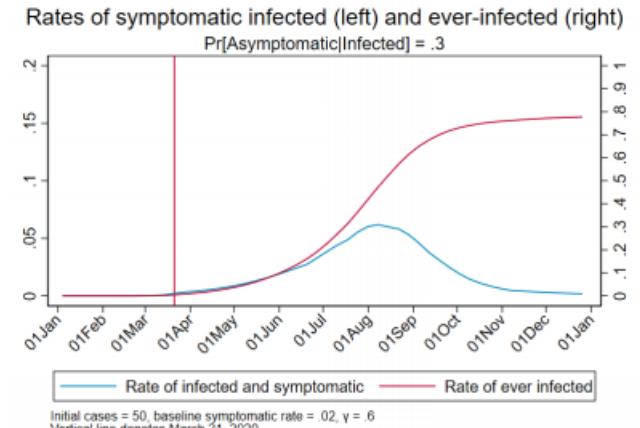
$$\Delta I_t = \beta I_{t-1} \frac{S_{t-1}}{N} - \gamma I_{t-1}$$



**Figure 2. High asymptomatic rate, short-duration policy**

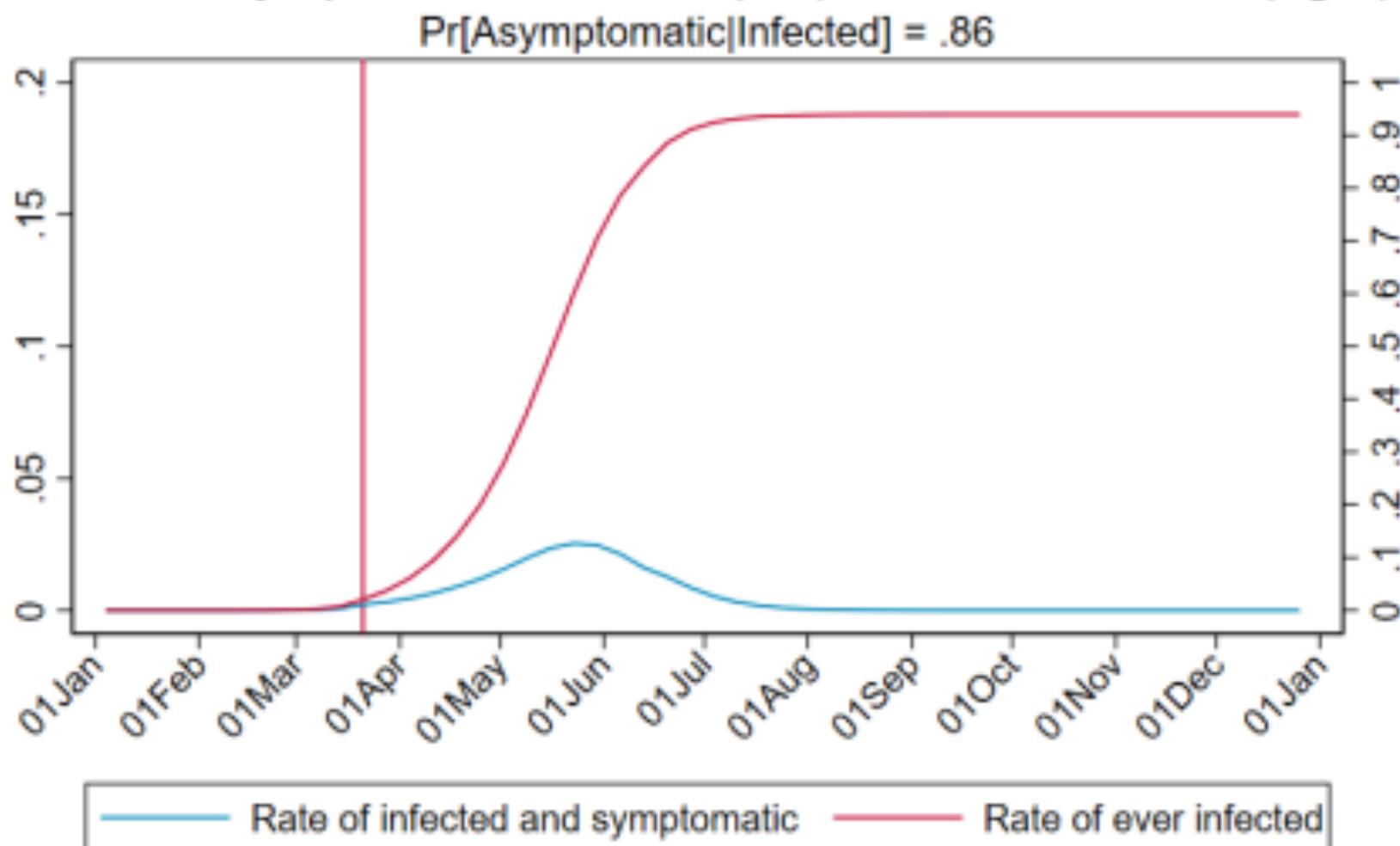


**Figure 4. Low asymptomatic rate, severe long-duration policy**



**Figure 2. High asymptomatic rate, short-duration policy**

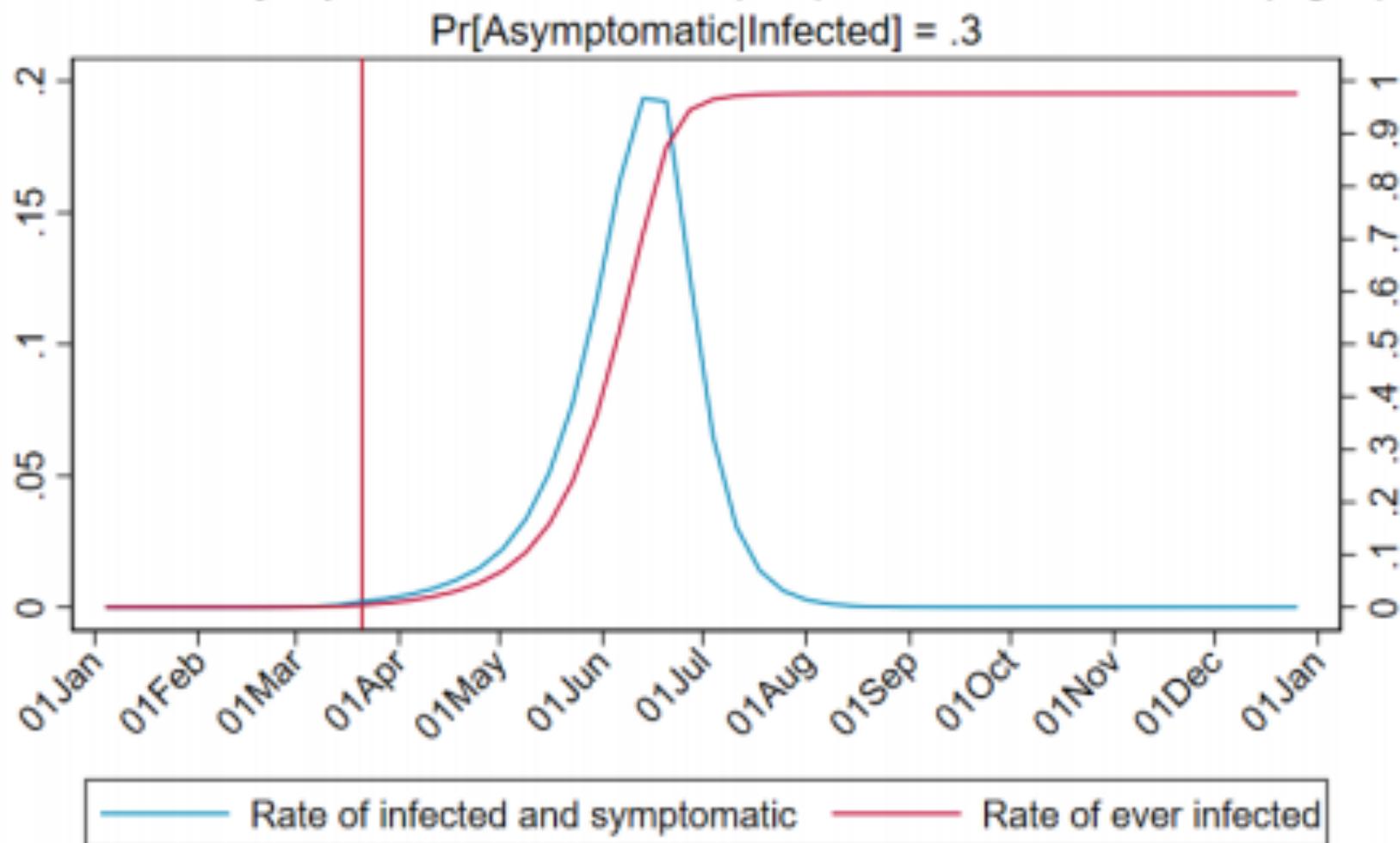
Rates of symptomatic infected (left) and ever-infected (right)



Initial cases = 50, baseline symptomatic rate = .02,  $\gamma = .6$   
Vertical line denotes March 21, 2020

**Figure 3. Low asymptomatic rate, short-duration policy**

Rates of symptomatic infected (left) and ever-infected (right)

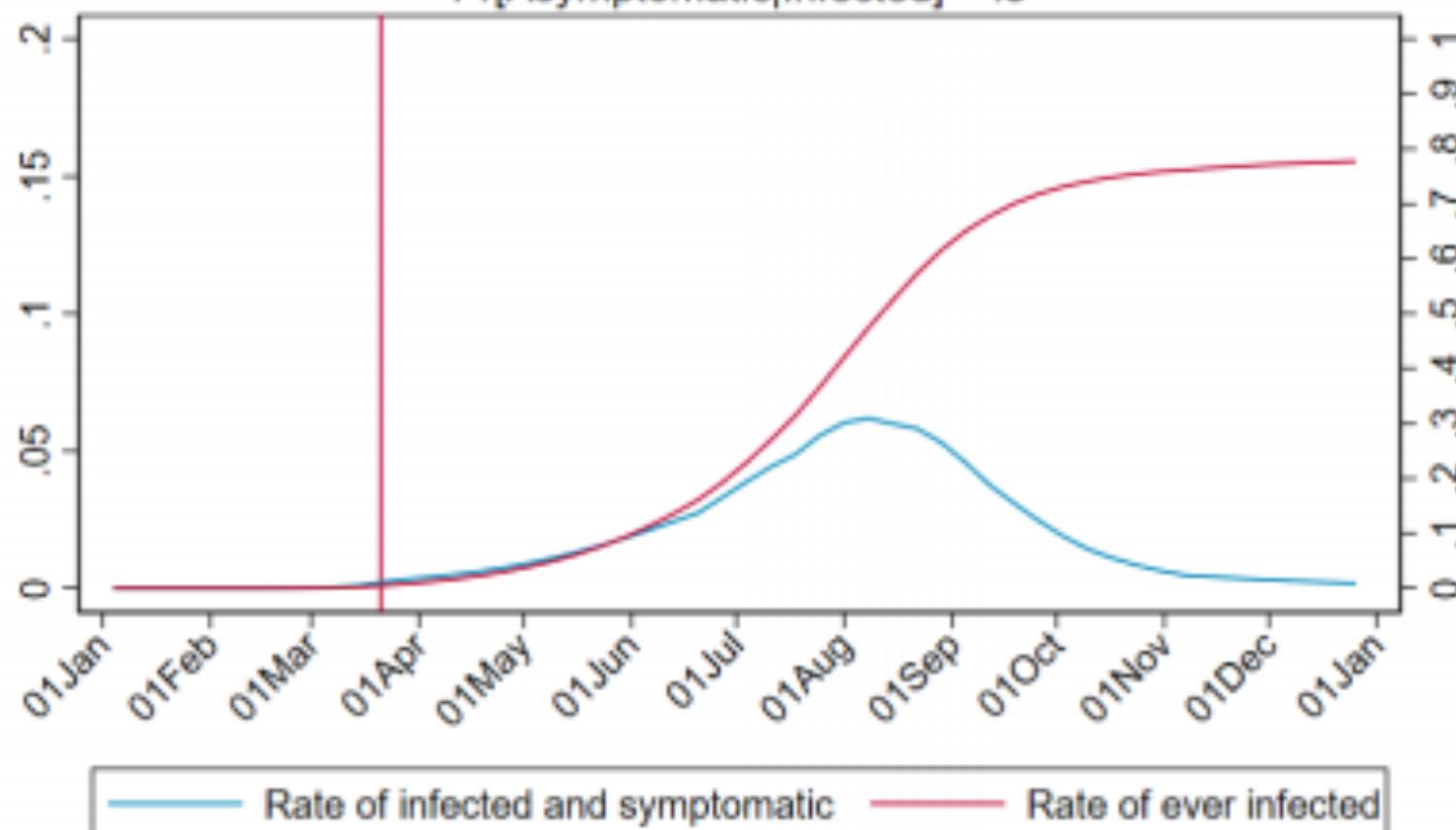


Initial cases = 50, baseline symptomatic rate = .02,  $\gamma = .6$   
Vertical line denotes March 21, 2020

**Figure 4. Low asymptomatic rate, severe long-duration policy**

Rates of symptomatic infected (left) and ever-infected (right)

$$\Pr[\text{Asymptomatic} | \text{Infected}] = .3$$



Initial cases = 50, baseline symptomatic rate = .02,  $\gamma = .6$   
Vertical line denotes March 21, 2020

$$\Delta S_t = -\beta I_{t-1} \frac{S_{t-1}}{N}$$

$$\Delta R_t = \gamma I_{t-1},$$

$$\Delta I_t = \beta I_{t-1} \frac{S_{t-1}}{N} - \gamma I_{t-1}$$

# Bringing the Economy Back Up from Anæsthesia

## Major issues:

- Certificates of immunity:
  - Which requires test, test, test:
    - And not just disease virus tests
    - Presence-of-antibodies tests
- How quickly can we match the immune with public-contact jobs?
- What jobs can be done with minimal infection risk?
- What minimal-infection substitutes can we find for previous jobs?
- How quickly can restrictions be relaxed without the virus coming roaring back?
- How do we avoid having the market give a “shutdown” signal to enterprises we in fact want restarted?
  - Which is pretty much all of them
- How much of the potential caseload do we want to push out beyond the vaccine-arrival date?

**ALL THESE QUESTIONS ARE ANSWERABLE IF WE LEARN THE ASYMPTOMATIC HENCE NON-TESTED RATE!!**

# Keeping the Economy from Crashing During the Lockdown

Nick Rowe <[https://worthwhile.typepad.com/worthwhile\\_canadian\\_initi/2020/03/relative-supply-shocks-unobtainium-walras-law-and-the-coronavirus.html](https://worthwhile.typepad.com/worthwhile_canadian_initi/2020/03/relative-supply-shocks-unobtainium-walras-law-and-the-coronavirus.html)>:

- We need a good RBC economist...
- A temporary 100% output cut in 50% of the sectors (what the Coronavirus does) is very different from a 50% output cut in 100% of the sectors
- Nick's thought experiment:
  - In three months we are going to invent unobtanium:
    - Substantial intertemporal substitutability
    - Plus lower cross-good contemporaneous substitutability
    - Hence high desired savings rate now
  - Flex-price market thus produces a nominal rate at the zero lower bound and a high inflation rate over the next three to six months
  - Can we get there? Should we get there? What should we do instead?

# Keeping the Economy from Crashing During the Lockdown II

**Nick Rowe <[https://worthwhile.typepad.com/worthwhile\\_canadian\\_initi/2020/03/relative-supply-shocks-unobtainium-walras-law-and-the-coronavirus.html](https://worthwhile.typepad.com/worthwhile_canadian_initi/2020/03/relative-supply-shocks-unobtainium-walras-law-and-the-coronavirus.html)>:**

- Plus: to extend the thought experiment:
  - We just lost the ability to make “unobtainium”
  - So we *should* be substituting leisure for work, and moving workers into relatively unproductive labor, making the commodities we can still produce right now
  - How should relative prices move as a result? How should we make them move?

**Plus: distributional issues**

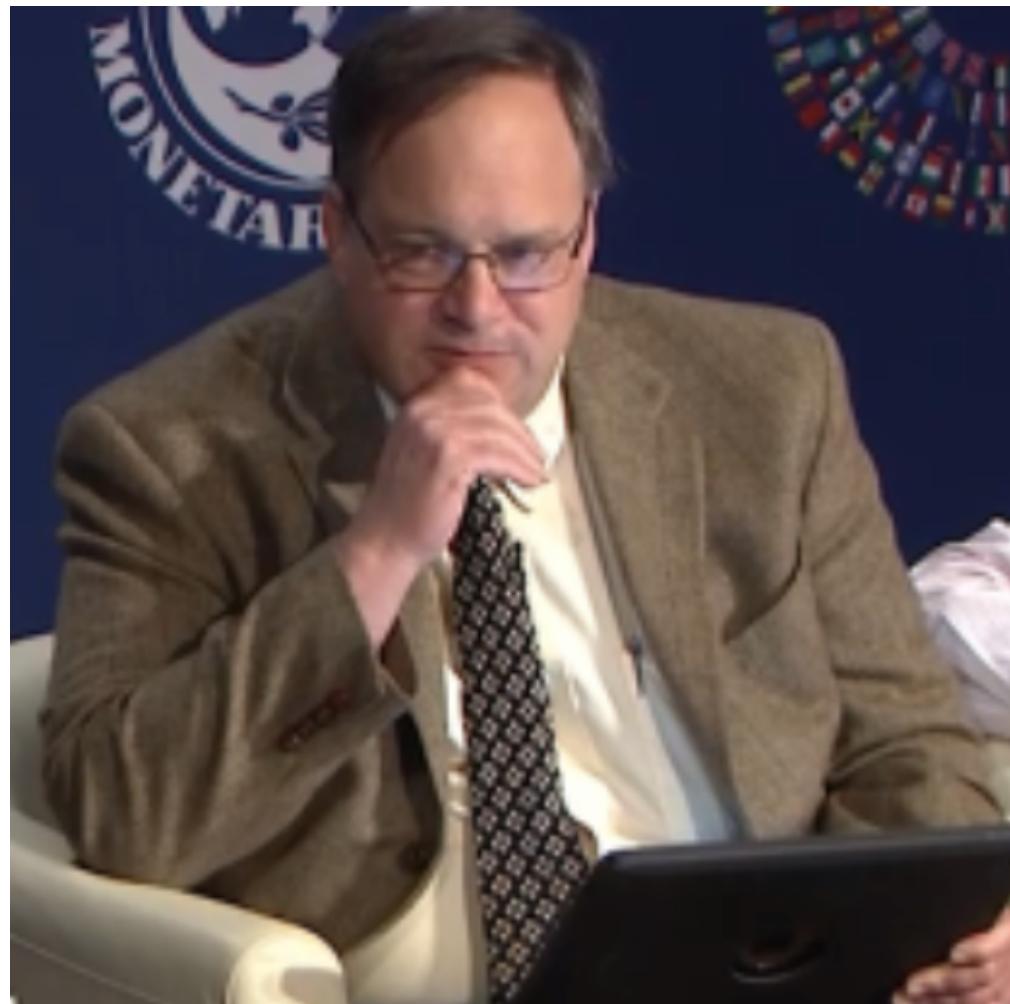
**Plus: bankruptcy and credit chain issues**

# References

- **Financial Times** (2020): Coronavirus Tracked: The Latest Figures as the Pandemic Spreads <<https://www.ft.com/coronavirus-latest>>
- **Nick Rowe** (2020): *Relative Supply Shocks, Unobtainium, Walras' Law, and the Coronavirus* <[https://worthwhile.typepad.com/worthwhile\\_canadian\\_initi/2020/03/relative-supply-shocks-unobtainium-walras-law-and-the-coronavirus.html](https://worthwhile.typepad.com/worthwhile_canadian_initi/2020/03/relative-supply-shocks-unobtainium-walras-law-and-the-coronavirus.html)>
- **Jim Stock** (2020): *Coronavirus Data Gaps and the Policy Response* <<https://drive.google.com/file/d/12MV466ZZy5xHir4xdPhoTrL1oO8CbZU-/view>>

# Catch Our Breath...

- Ask a couple of questions?
- Make a couple of comments?
- Any more readings to recommend?



# MOAR Coronavirus!

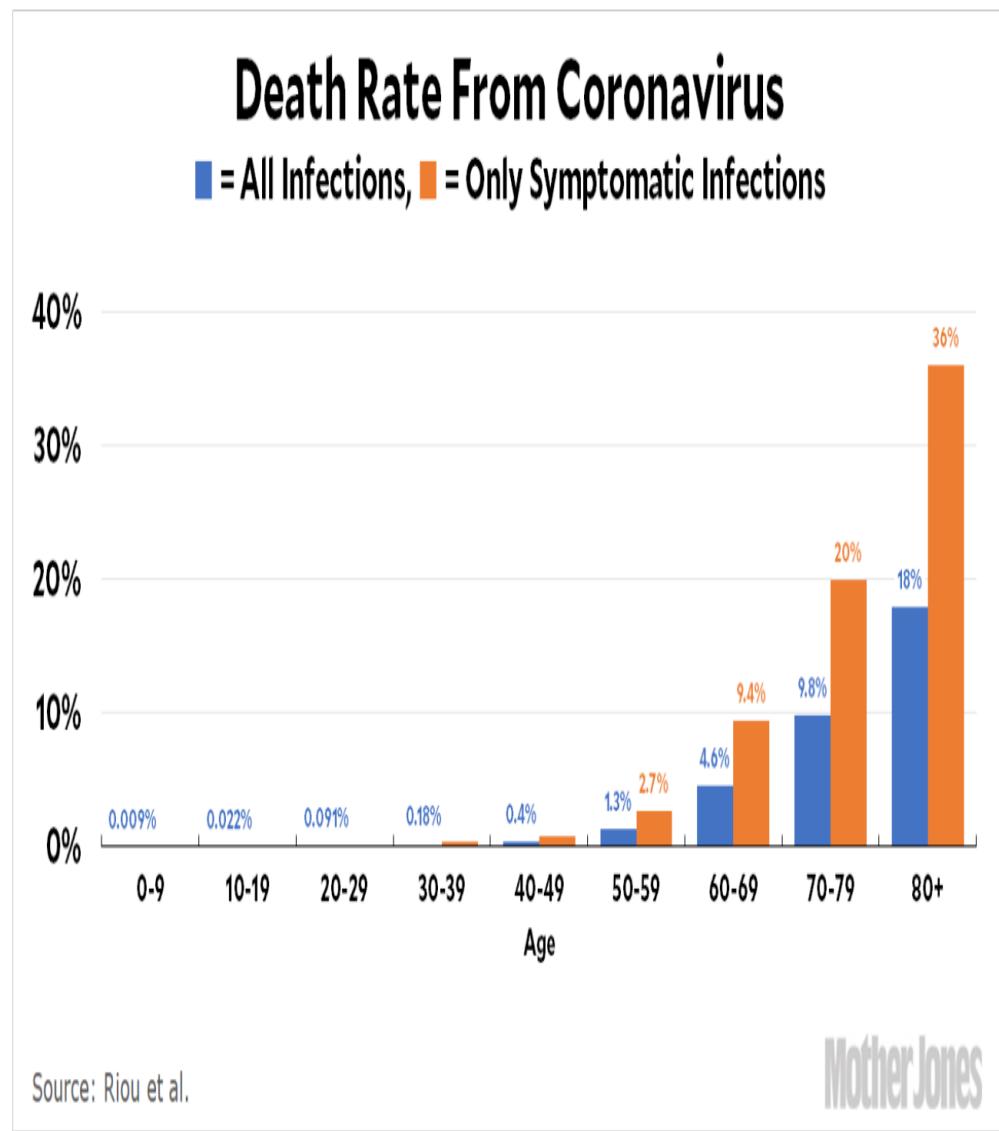
## What I am watching:

- **Max Roser & Hannah Ritchie:** *Coronavirus Disease (COVID-19)* <<https://ourworldindata.org/coronavirus>>...
- **Worldometer:** *Coronavirus Update (Live)* <<https://www.worldometers.info/coronavirus/>>: '125,599 Cases and 4,605 Deaths from COVID-19 Virus Outbreak...'
- *FT Coronavirus Tracker* <<https://www.ft.com/content/a26fbf7e-48f8-11ea-aeb3-955839e06441>>
- Josh Marshall's COVID Twitter List <<https://twitter.com/i/lists/1233998285779632128>>
- NEJM Group: Updates on the Covid-19 Pandemic <[http://m.n.nejm.org/nl/jsp/m.jsp?c=%40kxNtXckRDOq8oG0jJvAXsIzN4mPECIPhtxoTSdTU9k%3D&cid=DM89089NEJM\\_COVID-19\\_Newsletter&bid=173498255](http://m.n.nejm.org/nl/jsp/m.jsp?c=%40kxNtXckRDOq8oG0jJvAXsIzN4mPECIPhtxoTSdTU9k%3D&cid=DM89089NEJM_COVID-19_Newsletter&bid=173498255)>: 'From the New England Journal of Medicine, NEJM Journal Watch, NEJM Catalyst, and other trusted sources...'

# MOAR Coronavirus!

## Death for Geezers!

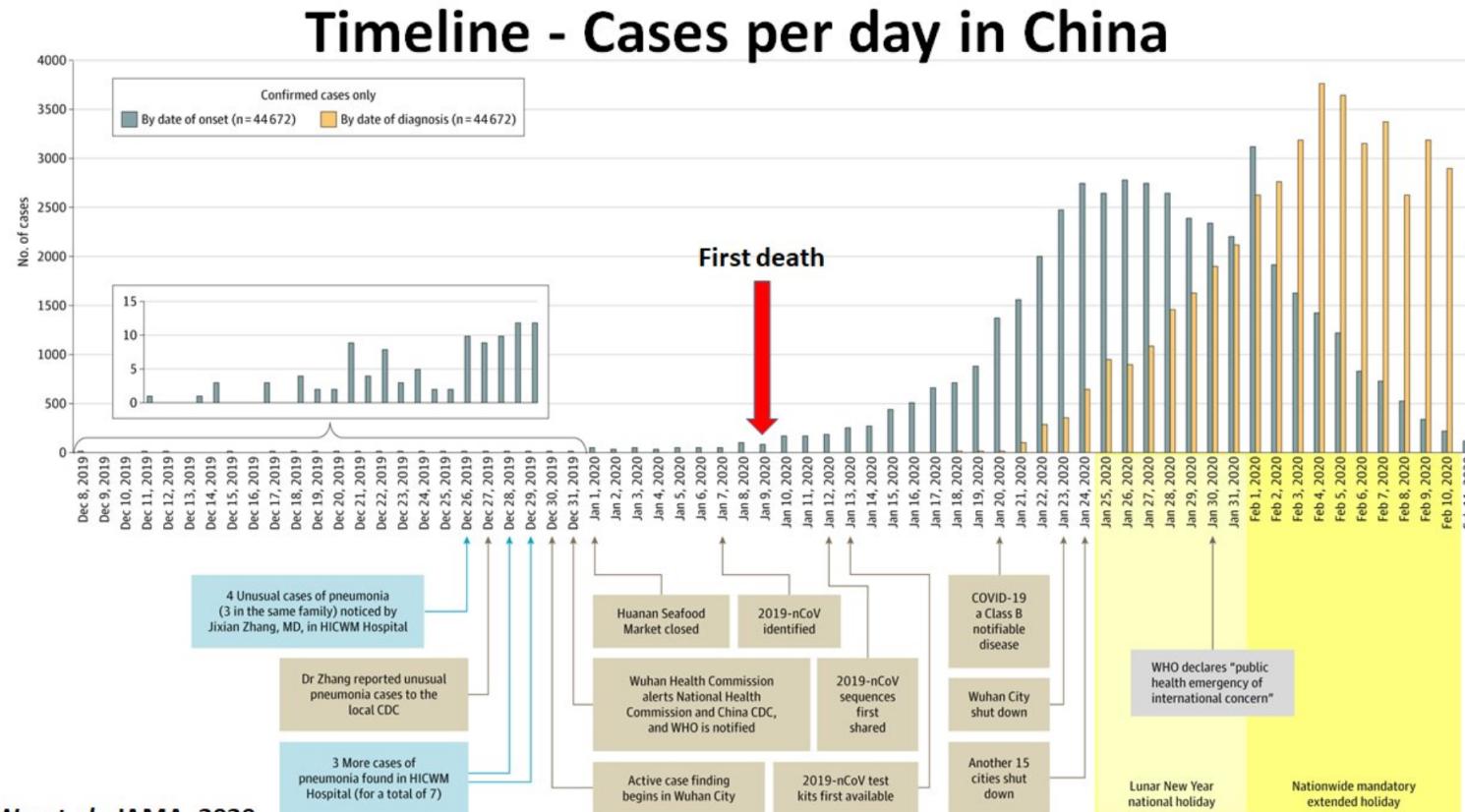
- Mortality for the Youngs very low...
- It's the flu for them—for you...
- And an extra doubling—or is it 5%?—mortality for the asthmatic
- And an extra doubling—or is it 5%?—mortality for the overweight



# What We Think Happened in Wuhan

China beat it quickly & relatively easily!

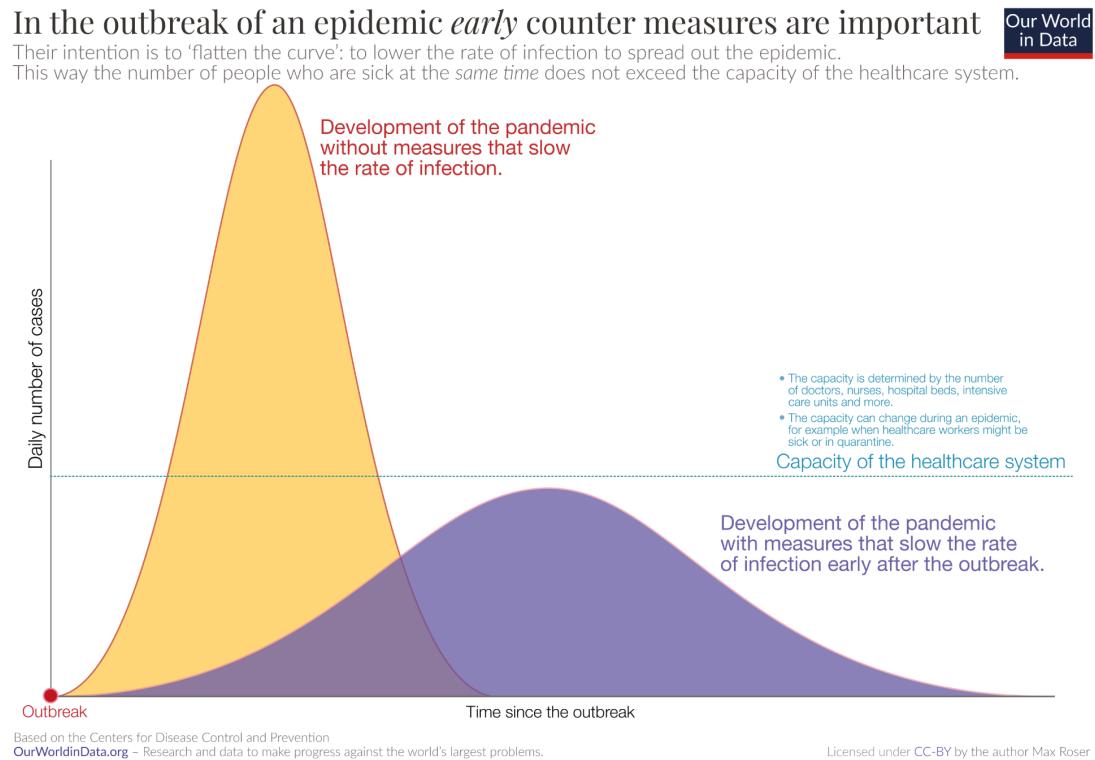
- We think
- Shut down Wuhan when 200 cases per day
- That seems to have been a good decision



# The Goal

## When Is It Appropriate to Move on This?

- Immediate social distancing...
- Self-isolate if you have a cough and a fever...
- Hope that warmer temperatures will do to this what they did to SARS...
- Otherwise, when do you want to start spreading out transmission. It seems that early is as good as later, so do it early...
  - I have no good intuition on why you want to move early
  - Plus your moving early will be wasted if you get reinfected
  - Plus the sparks you throw off making others' lives more difficult



# Coronavirus! (March 16)

**With 31 deaths in the U.S. as of March 11, a 1% death rate, and up to 4 weeks between infection and death, that means that as of Feb 12 there were 3100 coronavirus cases in the United States.**

**With 87 deaths in the U.S. as of Mar 16, a 1% death rate, and up to 4 weeks between infection and death, that means that as of Feb 17 there were 8700 coronavirus cases in the United States**

**If it is doubling every seven days, then now about 150,000 people have and in the next week about 150,000 more people in the U.S. will catch coronavirus—which means 1/2200, currently 3500 of the 7.6 million inhabitants of San Francisco Bay. Touch a hard surface that any of those 3500 has touched in the last 48 hours, and the virus has a chance to jump to you...**

**These numbers could be five times too big. These numbers are probably not five times too small unless the thing is a lot less deadly, and there are a lot of asymptomatic cases...**

- What is wrong with this analysis?

# MOAR Coronavirus!

**As of March 21: Things are not moving in the right direction:**

- What is the  $R_0$ ?
- How can the  $R_0$  be changed?
- How will the  $R_0$  change?
- What is the asymptote share of the population?
- What is the mortality rate?

| Country, Other              | Total Cases | New Cases | Total Deaths | New Deaths | Total Recovered | Active Cases | Serious, Critical | Tot Cases/1M pop |
|-----------------------------|-------------|-----------|--------------|------------|-----------------|--------------|-------------------|------------------|
| <a href="#">China</a>       | 80,880      | +36       | 3,213        | +14        | 67,819          | 9,848        | 3,226             | 56.2             |
| <a href="#">Italy</a>       | 27,980      | +3,233    | 2,158        | +349       | 2,749           | 23,073       | 1,851             | 462.8            |
| <a href="#">Iran</a>        | 14,991      | +1,053    | 853          | +129       | 4,590           | 9,548        |                   | 178.5            |
| <a href="#">Spain</a>       | 9,428       | +1,440    | 335          | +41        | 530             | 8,563        | 272               | 201.6            |
| <a href="#">S. Korea</a>    | 8,236       | +74       | 75           |            | 1,137           | 7,024        | 59                | 160.6            |
| <a href="#">Germany</a>     | 7,241       | +1,428    | 15           | +2         | 65              | 7,161        | 2                 | 86.4             |
| <a href="#">France</a>      | 5,423       |           | 127          |            | 12              | 5,284        | 400               | 83.1             |
| <a href="#">USA</a>         | 4,186       | +506      | 73           | +5         | 73              | 4,040        | 12                | 12.6             |
| <a href="#">Switzerland</a> | 2,353       | +136      | 19           | +5         | 4               | 2,330        |                   | 271.9            |
| <a href="#">UK</a>          | 1,543       | +152      | 55           | +20        | 52              | 1,436        | 20                | 22.7             |
| <a href="#">Netherlands</a> | 1,413       | +278      | 24           | +4         | 2               | 1,387        | 45                | 82.5             |
| <a href="#">Norway</a>      | 1,323       | +67       | 3            |            | 1               | 1,319        | 27                | 244.0            |

Coronavirus Cases:

**179,836**

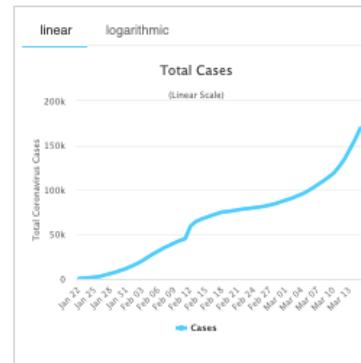
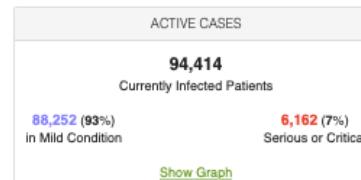
[view by country](#)

Deaths:

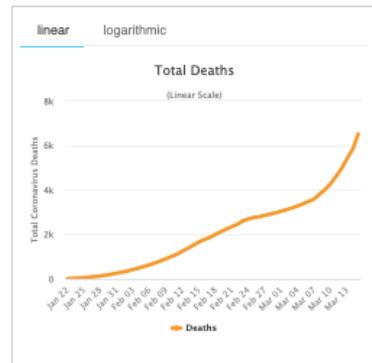
**7,098**

Recovered:

**78,324**



[More Case Statistics](#)



[More Death Statistics](#)

# MOAR Coronavirus!

**As of March 10: Things are not moving in the right direction:**

- What is the  $R_0$ ?
- How can the  $R_0$  be changed?
- How will the  $R_0$  change?
- What is the asymptote share of the population?
- What is the mortality rate?

Coronavirus Cases:

**125,599**

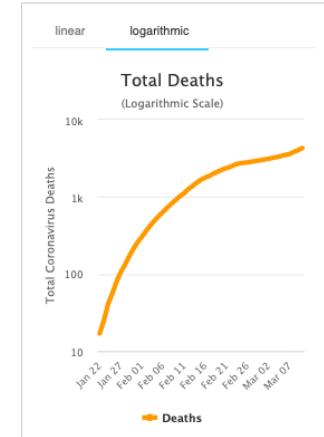
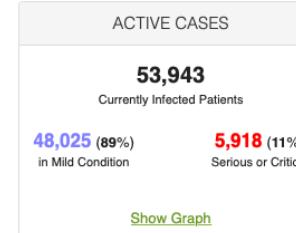
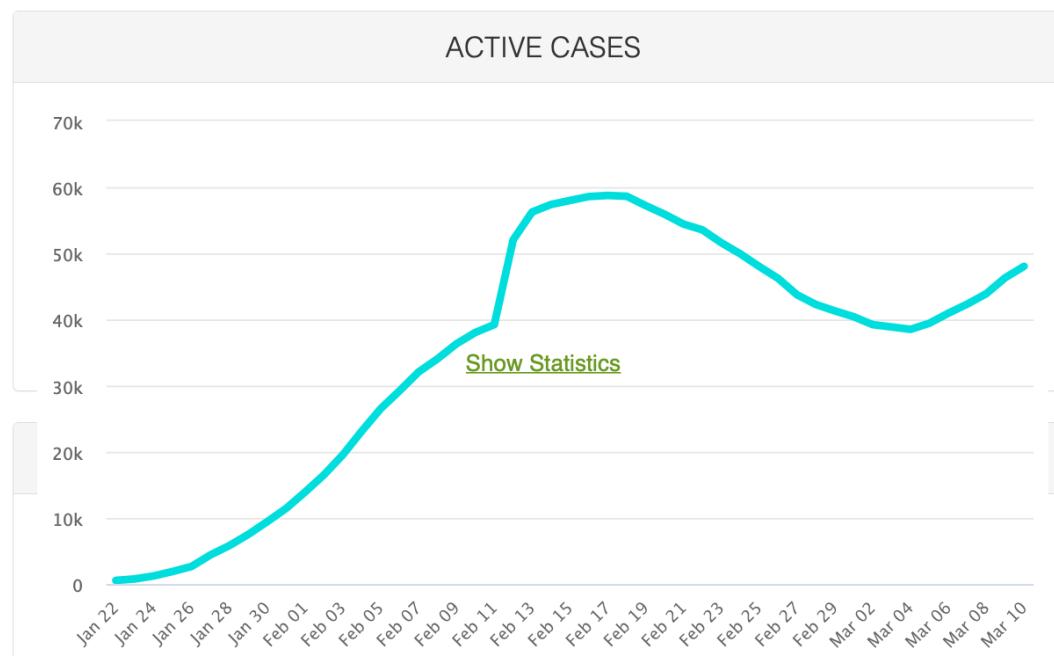
[view by country](#)

Deaths:

**4,605**

Recovered:

**67,051**



# Notes

