

A model of Covid-19 in the US with behavioral responses and back-pressure from economic concerns

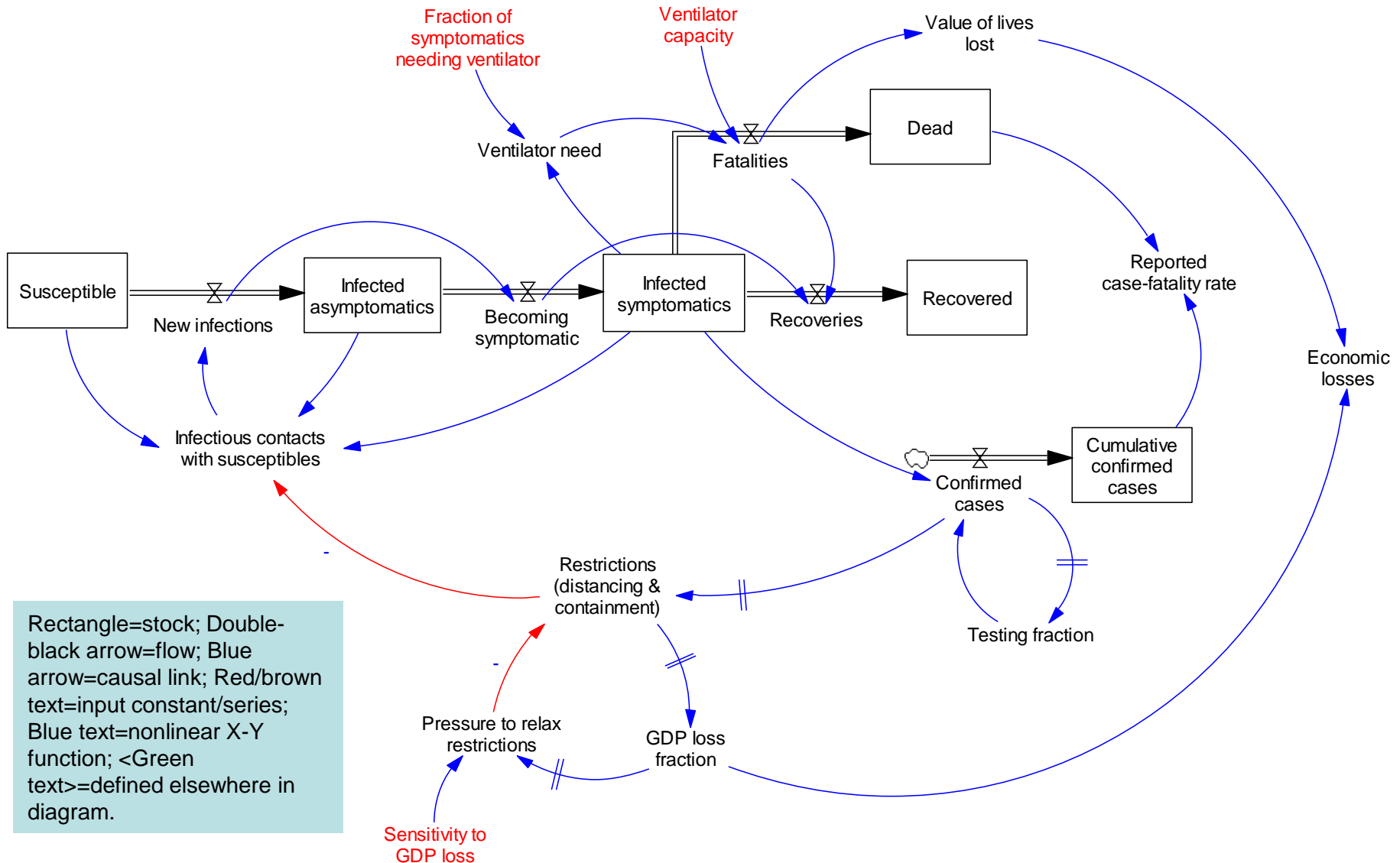
Jack Homer, PhD
Barrytown, NY

March 24, 2020 (ver. 2c)

The economic concern

- In recent days, we have seen increasing concern in the US about the potential economic impact of distancing and confinement restrictions related to Covid-19.
- The White House and many politicians are now calling for us to “get back to work” if things do not look too bad by the end of March (one week from now).
- They cite projections of a likely deep recession, e.g. this article from McKinsey: <https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/safeguarding-our-lives-and-our-livelihoods-the-imperative-of-our-time>
- They also cite the “get back to work” strategy espoused by lifestyle doctor David Katz and echoed in an editorial by Thomas Friedman:
 - <https://www.nytimes.com/2020/03/20/opinion/coronavirus-pandemic-social-distancing.html>
 - <https://www.nytimes.com/2020/03/22/opinion/coronavirus-economy.html>
 - The McKinsey article proposes something similar: “safeguarding our lives and our livelihoods”
- Some public health experts object to this “get back to work” idea, claiming it is dangerous. E.g.: <https://www.nytimes.com/2020/03/23/opinion/letters/coronavirus-quarantine.html>
- Is there a Covid-19 strategy that can both save lives and prevent harm to the economy?
- I’ve enhanced my simulation model to address these questions. See next slide.

Overview of the latest model (v2c)

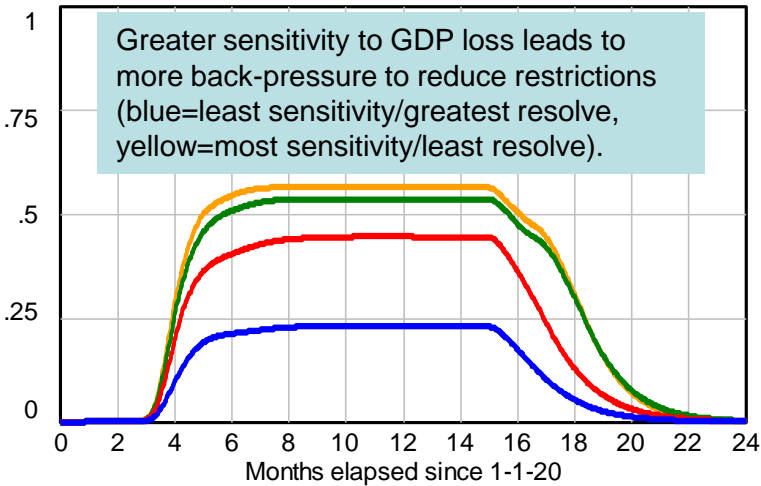


Assumptions and simulations performed

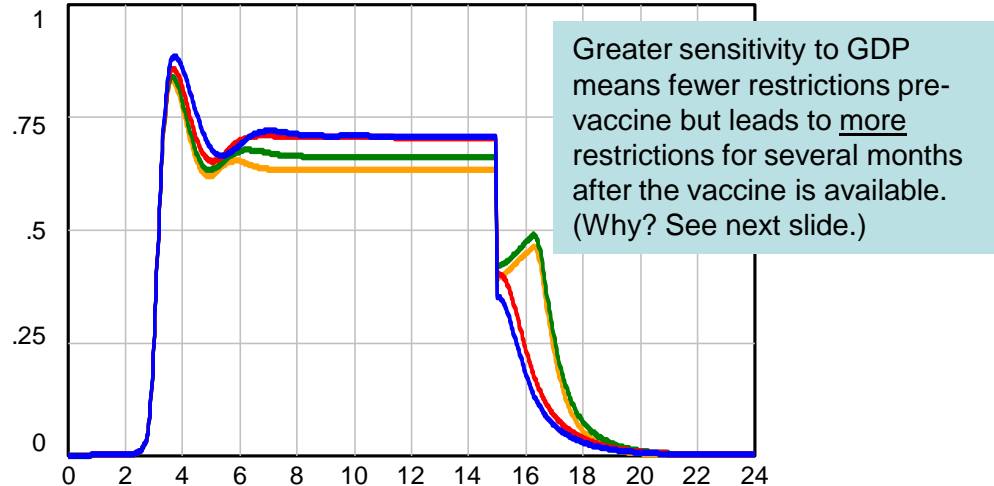
- Assumptions:
 - “Extent of restriction” = Social distancing + (1-Social distancing)*Containment measures
 - GDP loss fraction = (0.15 * Extent of restriction) with 1-month delay
 - “Restriction loosening due to GDP loss” undermines restrictions when GDP has been down for the past 2 weeks. The higher the GDP loss fraction, the more such back-pressure is applied.
 - The model keeps track of two types of economic losses: (1) GDP losses (relative to reference \$67k per capita, or \$22.1 trillion); and (2) value of lost life from Covid-19 fatalities.
 - Average 16 years of life lost per fatality (Zhou et al Lancet: avg non-survivor age 69), multiplied by \$100k per year valuation (a standard value used by health economists) = \$1.6m per death.
- Four runs varying the sensitivity to GDP loss (more sensitivity = less resolve to maintain restrictions):
 - “BP22” (least sensitive=greatest resolve), producing back-pressure of 22% when GDP loss=10%;
 - “BP42” (intermediate sensitivity), producing back-pressure of 42% when GDP loss=10%;
 - “BP54” (quite sensitive), producing back-pressure of 54% when GDP loss=10%;
 - “BP59” (most sensitive=least resolve), producing back-pressure of 59% when GDP loss=10%.

Results: back-pressure, GDP loss, net restriction

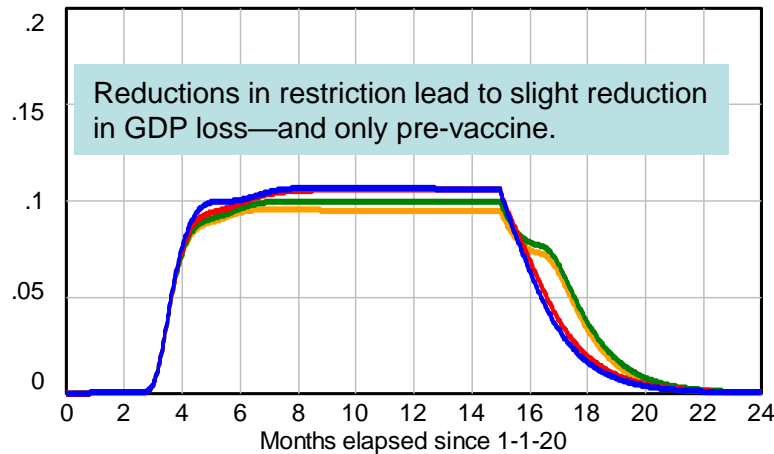
Restrict back-pressure due to GDP



Net extent of restriction



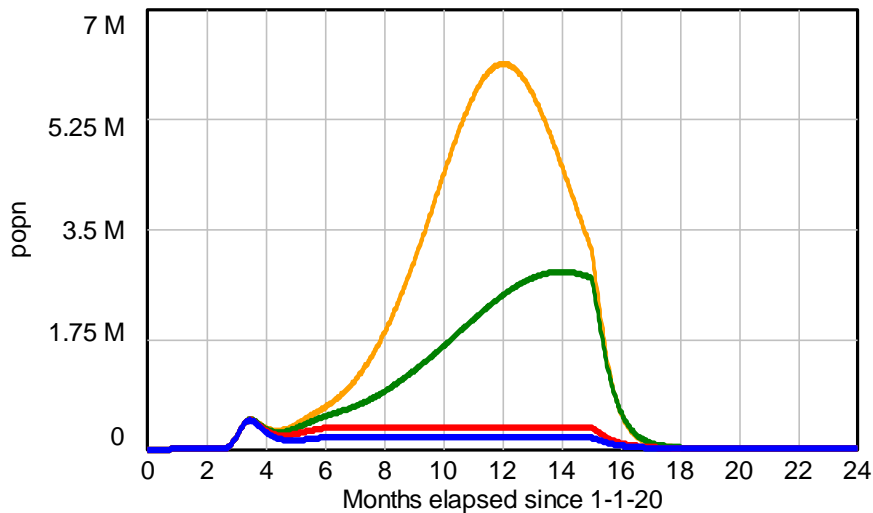
GDP loss fraction



- GDP loss fraction : BP22 —
- GDP loss fraction : BP42 —
- GDP loss fraction : BP54 —
- GDP loss fraction : BP59 —

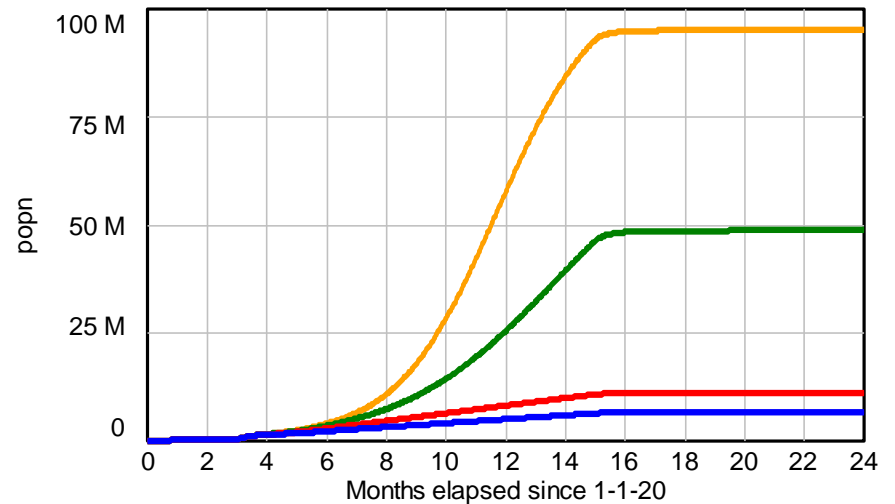
Results: Confirmed cases

Confirmed current cases



Confirmed current cases : BP22 —
Confirmed current cases : BP42 —
Confirmed current cases : BP54 —
Confirmed current cases : BP59 —

Cumulative confirmed cases



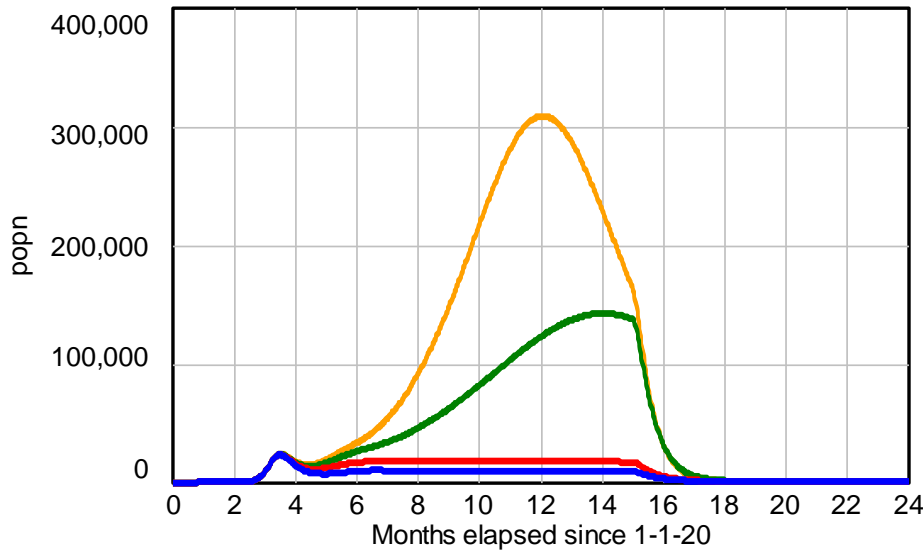
Cumulative confirmed cases : BP22 —
Cumulative confirmed cases : BP42 —
Cumulative confirmed cases : BP54 —
Cumulative confirmed cases : BP59 —

Greater sensitivity to GDP loss (i.e., weaker resolve) leads to fewer restrictions and allows much greater growth in virus transmission. With the strongest resolve (blue line), cumulative cases are held to 6 million; with weakest resolve (yellow line), they climb to 95 million.

In the runs with weaker resolve (green & yellow), the epidemic is still raging when the vaccine finally arrives at month 15 (April 2021). The vaccine has (by generous assumption) 80% reach and effectiveness, but the 20% gap still allows substantial transmission for a few more months. As a result, people remain afraid and continue practicing social distancing for several more months during 2021 (thus answering the questions from the previous slide).

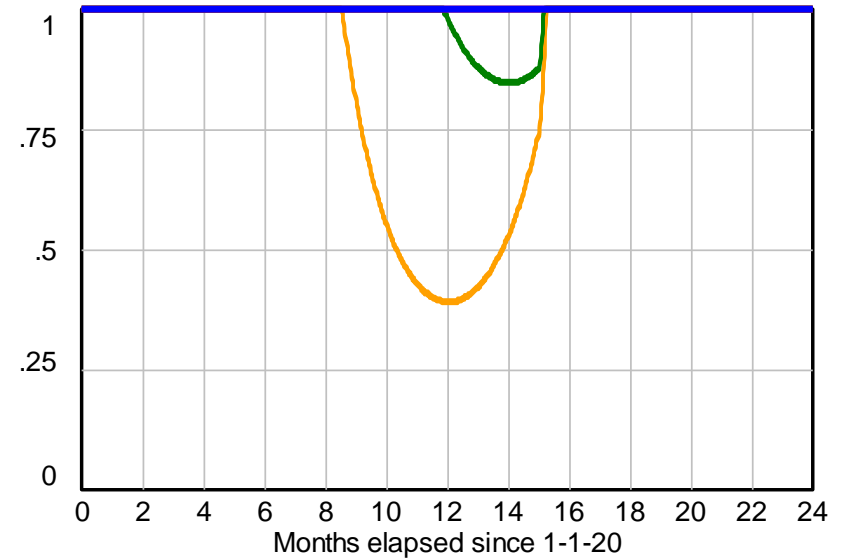
Results: Ventilator need & availability

Hospitalized needing ventilator



Hospitalized needing ventilator : BP22 —————
Hospitalized needing ventilator : BP42 —————
Hospitalized needing ventilator : BP54 —————
Hospitalized needing ventilator : BP59 —————

Ventilator relative availability

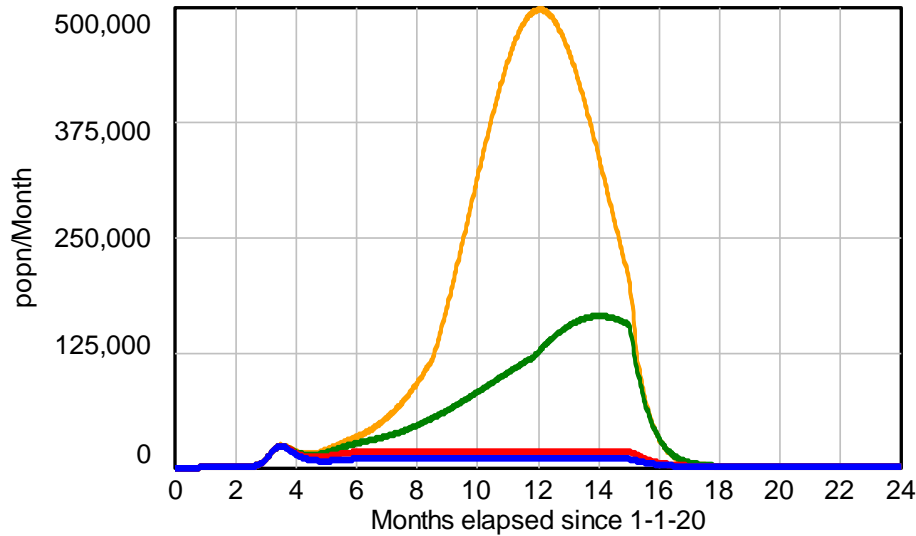


Ventilator relative availability : BP22 —————
Ventilator relative availability : BP42 —————
Ventilator relative availability : BP54 —————
Ventilator relative availability : BP59 —————

The huge surge of cases with weaker resolve (green & yellow) end up overwhelming ventilator capacity—until the vaccine finally arrives. With weak resolve (green), vent shortages start in December 2020 and are relatively moderate; with weakest resolve (yellow), they start in September and are severe.

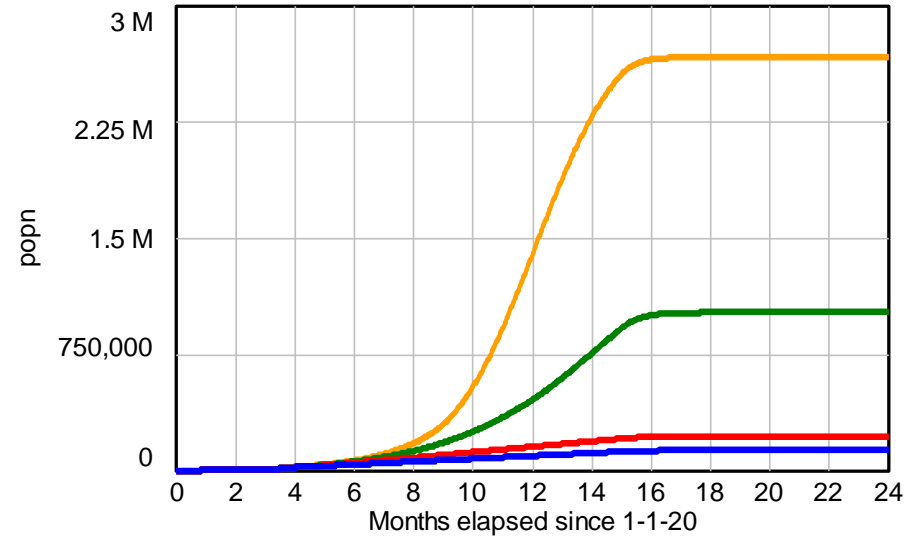
Results: Fatalities

Fatalities per month



Fatalities : BP22 — Fatalities : BP54 —
 Fatalities : BP42 — Fatalities : BP59 —

Dead

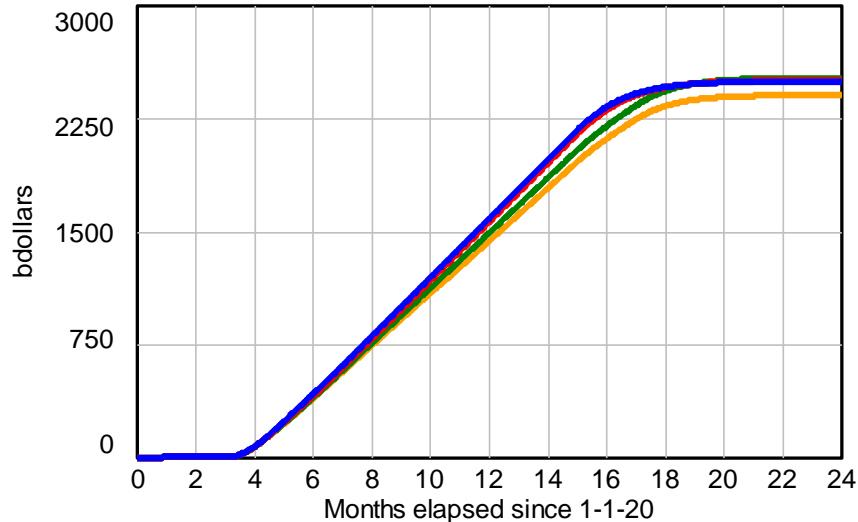


Dead : BP22 — Dead : BP54 —
 Dead : BP42 — Dead : BP59 —

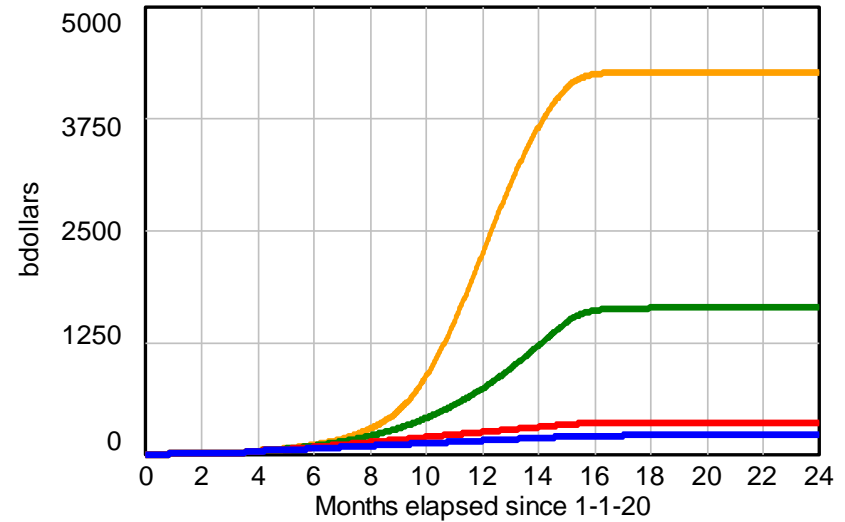
The high number of cases in the runs with weaker resolve (green & yellow), plus the ventilator shortages in those runs, lead to many more fatalities. Total dead are 130k in the run with strongest resolve (blue) and 220k in the next strongest (red); weaker resolve allows 1.0 million (green) dead or, most horribly, 2.7 million (yellow).

Results: Economic losses

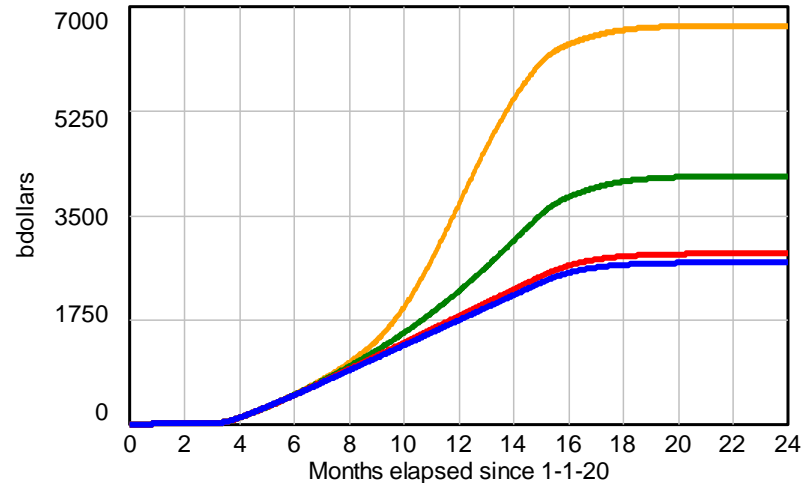
Cumul GDP loss billions



Cumul lost life value billions



Cumul combined loss billions



Cumul combined loss billions : BP22 —
 Cumul combined loss billions : BP42 —
 Cumul combined loss billions : BP54 —
 Cumul combined loss billions : BP59 —

GDP loss is reduced in the run with most GDP sensitivity (yellow), but only by \$100 billion (4%) relative to the \$2.5 trillion GDP loss of the other scenarios. Why is so little gained? With strong sensitivity (= weak resolve), cases surge, leaving no choice but to leave many restrictions in place—but not enough to knock the epidemic down.

The total value of lost life grows enormously in the runs with weakest resolve, from \$200B (blue/strongest resolve) to \$1.6T (green/weak) to \$4.3T (yellow/weakest).

Strong GDP sensitivity (= weak resolve) thus adds up to greater total economic losses: from \$2.7T (blue) to \$2.9T (red), to \$4.1T (green), to \$6.7T (yellow).

Conclusion

- I started by asking: Is there a Covid-19 strategy that can both save lives and prevent harm to the economy?
- The simulations here suggest that there is no such strategy: no way to simultaneously “safeguard our lives and our livelihoods”, as the McKinsey article would have it.
- Rather, concern about avoiding GDP losses undermines our resolve and allows the epidemic to explode. This would force halfway restrictions for many months to come—and would not avoid a recession after all.
- We should heed the public health experts telling us this is no time to be weakening our resolve, as well as the wise advice of U Penn’s Ezekiel Emanuel:
<https://www.nytimes.com/2020/03/23/opinion/contributors/us-coronavirus-response.html?action=click&module=Opinion&pgtype=Homepage>
 - “[T]he economy cannot be fixed without solving the pandemic. Only **after the virus is contained** can we reopen restaurants, bars, gyms and stores; allow people to travel, attend conferences and visit museums; and persuade them to buy cars and houses...
 - The Treasury Department should **issue grants** for up to 12 months to closed businesses with fewer than 1,000 workers to cover 80 percent of the equivalent of 2019 wages and benefits for their furloughed employees. These companies should also be allowed to borrow at zero interest up to last year’s revenue.
 - States should get block grants to **create temporary jobs** needed to control the public health crisis, such as workers for testing centers, thermal screening in public places, widespread contact tracing, quarantine monitoring and disinfecting public transportation and public places.”