

The Grumpy Economist

John Cochrane's blog

Saturday, November 14, 2020

Budish Covid-19 update

Eric Budish has [an update](#) to his excellent Covid-19 paper. Eric has a few deep central insights about pandemic management, which necessarily joins economics and epidemiology.

Keep your eyes on $R < 1$.

The reproduction rate R -- how many people the average person who gets the disease passes it on to -- is really the only thing that matters. When $R > 1$ the disease grows, initially exponentially, then only tailing off when a large (half or more) of the population is either immune or dead. When $R < 1$, the disease tails off. The costs of the disease grow enormously when $R > 1$. Once $R < 1$, further reductions in R don't really do much good.

From a public health perspective, you don't have to stop all transmission. Just get R less than one.

Thus, *The goal of pandemic policy must be to maximize the economy (maximize utility, if you're an economist) while keeping $R < 1$.*

The costs of changing R are so smooth, and the benefits so nonlinear, we might as well treat $R < 1$ as a constraint.

...the formulation provides economics language for a policy middle ground between society-wide lockdown and ignore-the-virus, and a new infectious threat response paradigm alongside "eradicate" and "minimize".

Important simple insights:

the $R \leq 1$ constraint imposes a disease- transmission budget on society. Society should optimally spend this budget on the activities with the highest ratio of utility to disease-transmission risk, dropping activities with too low a ratio of utility to risk.

Contra most epidemiologists, you don't shut down everything. You accept risk, and even some transmission, where it is important. From my priorities, keeping business and school open is more important than bars nightclubs and parties, but gustibus do matter here. Market value is a good test however.

Second, masks, tests, and other simple interventions increase activities' utility-to-risk ratios, and hence expand how much activity society can engage in and utility society can achieve while staying within the $R \leq 1$ budget.

This is a deeply important point, which I really had not grasped:

Do not evaluate the value of mask-wearing by how much it can reduce the spread of disease. Evaluate the value of mask-wearing by the value of activities we can open up, while keeping the disease spread constant.

That includes activities which can open safely if people wear masks while doing them, but also activities that can open if people wear masks elsewhere.

A simple numerical example, based on estimates from the medical literature for R_0 and the efficacy of facemasks and complementary measures, suggests the potential gains are enormous.

Eric does not draw one conclusion, which I suggest he does:

Policy should assiduously focus on measuring the reproduction rate, and policy initiatives should be keyed to that measure.

Right now, national, state, and local lockdown measures are keyed to the test positivity rate, which the media are also obsessed with. *The test positivity rate is about the dumbest number to look at and control. Using the test positivity rate or even the correct prevalence of infectious people to gauge policy guarantees covid cycles.*

The test positivity rate takes the people who happen to come in for any reason to get a test, and measures what fraction are positive. 10 in 100 is the same as 1000 in 100000. As in that example, you can have the same test positivity rate with vastly different fractions of people in the community infectious, and thus vastly larger danger of going out. Even if we do measure the correct fraction of people infected,

About Me and This Blog



John H. Cochrane

This is a blog of news, views, and commentary, from a humorous free-market point of view. After one too many rants at the dinner table, my kids called me "the grumpy economist," and hence this blog and its title. In real life I'm a Senior Fellow of the Hoover Institution at Stanford. I was formerly a professor at the University of Chicago Booth School of Business. I'm also an adjunct scholar of the Cato Institute. I'm not really grumpy by the way! Any opinions I express are mine alone and do not represent the position of the Hoover Institution or Stanford University.

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via random testing (a big improvement), it is a mistake to crack down when that number is large, and to ease up when that number is small. Ease up when small leads to a high reproduction rate, and the cycle restarts. Measure, and respond to the *reproduction rate*.

Eric also does not draw out the very detailed adaptations that need to take place on a case by case basis. The rules for an auto-body paint shop are different from those for a gym. As usual there is no hope that regulators will get this right, especially in the time involved, without massive confusion.

The paper now includes a very good review of literature on simple interventions. Do masks work? You can hear opinion on both sides. After all, aerosols go right through the space between mask and cheek. Scandalously,

There is not yet an RCT study of masks.

P. 16 ff, however, has a long list of references and a bottom line,

the preponderance of evidence from various sorts of empirical studies, combined with common sense conceptual understanding based on how the virus is known to spread, all point to reductions that are significant, perhaps on the order of 50% or more in conjunction with complementary measures.

I wish that were a bit nuanced. After all, masks are clearly going to do a lot more good inside than 20 feet away from each other outside, and N95 masks are going to do a lot more good than a bandana. Masks have costs too, and blanket mask mandates impose costs. A subtle cost is that since most people know that wearing a mask outdoors in a 20 mph wind is silly, if government mandates that, then that undermines authority of mask recommendation that help.

Random mass testing is a second easy intervention. Again, Eric has a novel insight:

tests are therefore likely to be of especially high social value for activities that are both high pre-virus utility ...and high risk ... Additionally, tests are likely to be especially socially valuable for activities where facemasks and other cheaper interventions either are not sufficiently effective...or are too harmful to utility Congregate settings such as nursing homes may be an example of the former ... film and television production is an obvious example of the latter.

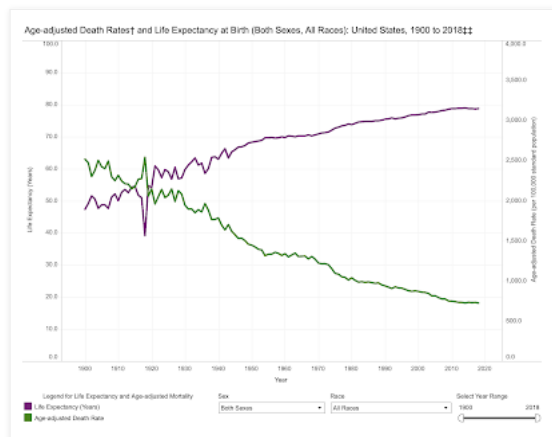
Eric's conclusion is insightful:

There are four features of Covid-19, relative to other past pandemics, that together make this formulation potentially appropriate:

1. Mortality / morbidity cost high: Covid-19 is sufficiently lethal and harmful that $R \leq 1$ is a desirable policy goal even at meaningful expense.
2. Eradication likely not feasible: Covid-19 had already spread relatively widely by the time of policy intervention in many countries, making eradication an unrealistic goal for many countries.
3. $R \leq 1$ feasible with modestly expensive measures: with an initial R_0 in the ballpark of 2.0-4.0, and a fast understanding of how the virus spreads, medical experts quickly converged upon a suite of public-health responses that together could achieve $R \leq 1$. As Atul Gawande put it: "we have learned in hospitals where we've been going to work every day in the pandemic and have avoided infections, that if you have hygiene, distancing, mandatory masks, and screen everybody for symptoms so that they stay home and get tested, that shuts the virus down." ...
4. Minimize unboundedly expensive:.... the minimize objective makes it difficult to think about tradeoffs if the interventions themselves are very expensive.

(To see how clearly Eric is thinking here, keep reading for his analysis of cases that violate these assumptions, and other policies would be appropriate.)

One fly in the ointment. Death rates are declining rapidly as better treatment comes about. Is this really sufficiently lethal, point 1? A commenter on a previous blog post pointed to the declining [death rate in the US from all sources](#)



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and points out that Covid-19 has put the US overall death rate at...where it was in 2006. Not good, but how much GDP and unemployment is that worth? If we want to spend that much GDP and unemployment to reduce death rates, are there not more efficient ways to do that? Ban sugary sodas rather than close bars?

The story of very large fractions of people with seemingly permanent after effects needs better quantification, as that seems now like the biggest unknown. But, paradoxically, the better treatment gets, the less the case for costly interventions.

Update: In response to comment. Yes, R is very different across activities, and most of the high average R is in a fat tail of super spreader events. That means that effort should be focused on super spreader events and not bother with small potatoes.

Update: [Tyler Cowen](#) adds a few good out of the box points one potshot at epidemiologists and the other at economists.

..long-run elasticities of adjustment are more powerful than short-run elasticities. In the short run you socially distance, but in the long run you learn which methods of social distance protect you the most.

And, I would add, which activities matter the most. We are seeing a rough and ready version of this now - politicians are not going to do a blanket lockdown.

public choice considerations. An epidemic path, for instance, may be politically infeasible, which leads to adjustments along the way, and very often those adjustments are stupid policy moves from impatient politicians.

Well, "stupid" may be "unavoidable." If a politician tried to really ramp up controls when the overall prevalence rate is low but R is spiking, as Budish would like, he or she would likely fail. Voters whose individual cost / benefit depend on the level of danger, not its rate of increase, will rebel at being denied bars and restaurants if 1/10,000 is becoming 2/10,000 overnight.

I save the best for last:

I also queried about the political orientation of epidemiologists (among other matters), and that occasioned a great deal of pushback and outrage. Yet we saw during the summer that many of them were explicitly political and favoring the Left, willing to abandon their earlier recommendations to endorse demonstrations for a cause they strongly favored. I am not sure how big was the resulting boost in cases or fatalities, but it did seem the American people concluded that you could ignore the rules if something was sufficiently important to you. Like visiting your relatives for Thanksgiving, and we will be reaping that harvest rather soon.

Posted by [John H. Cochrane](#) at [1:05 PM](#)

Labels: [Commentary](#), [Economists](#), [pandemic](#)

25 comments:

Anonymous November 14, 2020 at 1:30 PM

What do you think about the point made by Zeynep Tufekci that average R hides super-spreaders? <https://www.theatlantic.com/health/archive/2020/09/k-overlooked-variable-driving-pandemic/616548/> . Does that alter your analysis?

[Reply](#)



rudy November 14, 2020 at 5:11 PM

The present psycho-political and psycho-social space is not amenable to scientific policy making. Science is an elite word to so many it's sad ...

[Reply](#)



dogsanity November 14, 2020 at 5:29 PM

Two points: 1. Social utility is not instantaneous variable. Current action need to be properly discounted for future benefit. In fact, would be reasonable to argue that the short term equivalent discount curve for drastic action is large thanks to its positive benefit of lower mortality overall. Dropping R0 to very low number for a few weeks like SK is probably better than having R0 = 0.95 for 1yr. Just as exponential growth is unintuitive for the human mind and horrifying to watch, we can make it useful by flipping to exponentially diminishing. 2. The number of policy intended for general public should be a penalty term for utility. Having 25 policies for various social activities is a large mental burden for general public and doesn't necessarily translate to benefit. 3 good and crude policies are better than 25 finely tuned ones. Pandemic is a war and should be modeled as such, rather than a general economic policy.

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Benjamin Cole November 14, 2020 at 6:33 PM

Great post.

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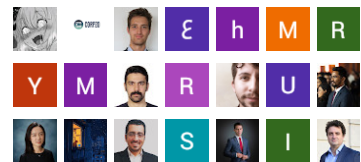
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I still wonder why almost no C19 in Thailand, heavily visited by China tourists (pre-shutdowns) or other SE Asian nations.

Africa is lightly touched also.

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DWAnderson November 15, 2020 at 4:15 PM

Lots of anomalies with SARS COV-2! The hypothesis that there are characteristics of those population that retard the spread in those populations (e.g. youth, cross-resistance, etc.) seems plausible.



RP November 22, 2020 at 1:12 AM

There has been some speculation that countries that routinely inoculate with BCG are seeing lower infection rates...India and South Africa for instance. Does Thailand utilize BCG?

[Reply](#)



yohannes November 15, 2020 at 2:42 AM

one component that your analysis is missing is the age dependence of the infection fatality rate (IFR). This is the single most important property of covid-19. Essentially, the fatality rate as a function of age is exponential. This is KNOWN. So the fatality rate of an 85 year old is over a 1000 times that of someone below the age of 30. You have to add this feature to your analysis. So the goal should be to reduce $R < 1$ AND minimize infections of the vulnerable. The later is absolutely critical. Not taking it into account makes your analysis essentially useless.

[Reply](#)



Fish Goldstein November 15, 2020 at 11:09 AM

Policymakers, like Doctors, have little to no training in handling uncertainty.

The standard method of analysis, is that "life is worth infinite utility...therefore, no dollar amount can account for the value of life and any risk to life must be avoided."

This does a poor job of explaining human behavior. Rather, what people do is the following:

"What is the expected utility I derive from life with risky behavior, and what is the expected utility I derive from life without risky behavior?"

So, for example, if the chance of dying from driving is 1%, and the difference in utility from life with driving vs. a life without driving is worth enough to offset the loss of utility from the 1% chance of dying, a rational person will drive.

This is how people make perfectly fine decisions that, on the whole, maximize utility while incorporating risk to life. And this is how policy should work.

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Bart Wauters November 17, 2020 at 2:22 PM

Given the epidemiological and economic uncertainties involved, it could be interesting to consider maximizing expected utility subject to a variant of the $R \leq 1$ constraint (a variant due to the uncertainty of the value of R) and other constraints and explicitly modeling risk using probability distributions. This will probably mean that it will be difficult to get analytical results and that simulation (for example agent based modeling) will be required.

As an economist, Eric Budish will be familiar with this type of reasoning. Probably he choose not to model risk explicitly in order to make the analysis more tractable (he mentions in the article why he chose a static model over a dynamic model, see "Remark on Related Literature: Static vs. Dynamic Models").

[Reply](#)



Quant November 15, 2020 at 11:31 AM

I mostly agree with you and Budish, but you write,

"From my priorities, keeping business and school open is more important than bars nightclubs and parties, but gustibus do matter here."

Of course, bars and nightclubs are businesses. And there is no clear dividing line between restaurants and bars. If you say that drinks cannot be sold alone, as Cuomo mandated, the bars will offer small food items along with drinks. So the question is which businesses will be sacrificed, and who gets to decide.

[Reply](#)

**Jacopo** November 15, 2020 at 3:14 PM

Very good post. In principle one should find a policy that gives $R_0=0.99$ and stick to it until vaccine. There are a few practical problems though, which make impossible to keep the policy constant and difficult to vary it promptly:

- R_0 is very difficult to measure in real time, both for small number of infected (because of fluctuations) and for large (if they exceed testing capabilities)
- seasonality: sweden found a policy which seemed to give $R_0<1$ in spring and stuck to it without changes, but it was insufficient in autumn
- change in available policy tools: we didn't have masks at the beginning. It was reasonable to relax other restrictions when introducing mask mandates. However, France eliminated almost all restrictions and bet that the masks would be enough to keep R_0 low, clearly a mistake.

An unrelated thought on "is it sufficiently lethal to justify the effort": you would want anyway to avoid hospital overcrowding. Which means that at some point you have to enforce $R_0\sim 1$ anyway. You might as well do it from the beginning, at small extra cost (assuming the way out is vaccine and not herd immunity).

[Reply](#)**Anonymous** November 15, 2020 at 4:27 PM

Two things: 1. Yes, the death rate has decreased with better treatment, but one issue that that receiving that treatment is conditional on the number of active cases. So it's not certain that as the US goes into this third wave, with hospitalizations spiking beyond capacity, the death rate will continue to be low.

2. My sibling is a doctor and has warned me that while most people live, their quality of life may be significantly affected through decreased lung and/or heart function and changes to the shape of blood vessels causing clotting. The details were sufficiently scary as to make me happy to wear a mask even on a windy day outside.

[Reply](#)**DWAnderson** November 15, 2020 at 4:28 PM

1. "Policy should assiduously focus on measuring the reproduction rate, and policy initiatives should be keyed to that measure." Is there a good way to do this? Unless you can efficiently do this and isolate the effect on R from various interventions and their combination, what do you do with this insight?

2. Maybe you want to offer people $R<1$ alternatives to traditional activities instead of just banning them. For example, I suspect a reaction to IL banning public indoor dining and gatherings of more than 10 people is that people are holding such gatherings in private homes (esp. now that it is cold in Chicago) where spread is even more likely than in well ventilated commercial spaces. Seems like this would be an ideal market for private certifications re R value of certain activities as certain venues rather than regulation as it is unlikely regulators would be sufficiently nimble in this regard.

[Reply](#)**Anonymous** November 15, 2020 at 6:59 PM

50% mask efficiency is a complete pipe dream. Most of those low-quality evidence is from the spring wave and is likely just picking up seasonality. We KNOW that masks in the community do squat for the flu. Which means masks likely do squat for Covid transmission by droplet. So, the only way masks could help if they lower aerosolized transmission, which is complete bullshit for cotton/low grade non-n95 masks. So, all this hand-waving is worthless if it assumes 50% mask effectiveness.

[Reply](#)[Replies](#)**Mr. Sunshine** November 16, 2020 at 6:06 PM

If "we KNOW masks do nothing for the flu," then how come there was virtually no flu in the Southern Hemisphere this season? Please cite source of this "know."

[Reply](#)**Bob Flood** November 16, 2020 at 7:50 AM

So why does it take 43 pages to make the point?

[Reply](#)**Old Eagle Eye** November 16, 2020 at 12:55 PM

De gustibus non disputandum est. There is no accounting for peoples' taste.

[Reply](#)**Old Eagle Eye** November 16, 2020 at 1:42 PM

Budish's model, as described in his paper, is a Linear Programming problem.

Max $x \cdot (v-c)$!a vector inner product.
x

Subject to

- (1) $x \cdot r \leq K$! also a vector inner product;
- (2) $x \cdot i = 1$! also a vector inner product; i is a vector of 1s;
- (3) $x \geq 0$! x is non-negative;
- (4) $0 < K \leq R0$! K is positive.

The first-order condition is $(v_k - c_k) - \lambda \cdot r_k - \varphi = 0$ for $k = 1, 2, \dots, m$, where λ and φ are Lagrange's unknown multipliers. The solution of the LP problem will lie on a vertex of one or more constraint hyperplanes, depending on the dimensionality (m) of the LP problem. And therein lies the 'rub'.

In the abstract, the LP problem is solvable provided the parameter values v_k , c_k and r_k are known for $k = 1, 2, \dots, m$. If not, you haven't much to go on—it becomes an arm-waving exercise.

If x is unconstrained, i.e., x can take on any real vector value, then the first order condition reduces to:

$$(v_k - c_k) - \lambda \cdot r_k = 0,$$

from which one obtains the optimality condition:

$$(v_k - c_k)/r_k = \lambda,$$

which can be expressed as:

$$(v_1 - c_1)/r_1 = (v_2 - c_2)/r_2 = \dots = (v_k - c_k)/r_k = \dots = (v_m - c_m)/r_m = \lambda.$$

Budish uses $(v_k - c_k)/r_k$ as an measure of benefit:risk ratio. But it only applies if Lagrange's multiplier φ is identically zero, i.e., it applies iff constraint (2) is non-binding.

The qualitative insights are important, but Budish doesn't examine the composition of r_k for practical situations. His assumption of the 'risk neutral' utility function is also not sufficiently explored.

If he had specified a power-law utility function or a quadratic utility function, then he might have been able to use the Karush–Kuhn–Tucker algorithm to solve the resulting non-linear optimization problem. However, dimensionality imposes severe constraints on solvability; and determining the coefficients of the problem objective and constraint equations limits the usefulness of Budish's approach to the social planner's problem.

[Reply](#)

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Old Eagle Eye November 20, 2020 at 2:26 PM

"Principle of Optimality: An optimal policy has the property that whatever the initial state and initial decision are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision. (See Bellman, 1957, Chap. III.3., Dynamic Programming)"
Quoted in Wikipedia: "Bellman Equation".

[Reply](#)



pointsandfigures.com November 16, 2020 at 1:58 PM

How about the addition of conditional probability? If I have a prior condition, the chances of me getting really sick and dying go up. If I am over the age of 70, my chances for dying go up. If I am young and healthy, my chances of dying are extremely low. If $R > 1$ in a bunch of healthy 18-49 year olds do we care as long as they aren't spreading it to vulnerable people? Hence your last post about a vaccine.

[Reply](#)



RDL November 16, 2020 at 2:07 PM

Why doesn't your approach consider the impacts of therapeutics like hydroxychloroquine that mitigate both the severity and adverse consequences, which in turn reduce the need for business and social restrictions?

[Reply](#)



Skeptic November 16, 2020 at 4:11 PM

There is a 6,000 person RCT - look for "Face masks for the prevention of COVID-19 - Rationale and design of the randomised controlled trial DANMASK-19" at pubmed. The study is complete but has been rejected by several journals. It may eventually find a publisher.

"Average R " incorrectly assumes that social interactions are random and homogeneous. In fact, many adults are mostly isolated with mean R near zero. Supermarket checkers and healthcare workers may transiently have high R - but they get infected and become immune early in any outbreak.

[Reply](#)

sk November 18, 2020 at 1:02 PM

Did not find anything new in this post. Been hearing for quite long time get Rnaught under 1; did that somehow disappear from the conversation? Common sense: Yes, biz open where makes sense and closed where it makes none. Deaths important, but from beginning major issue and one in view now is strain upon the hospital systems. If all got Covid with some unfortunate deaths, and most never need to go to a hospital the Virus would be much less of an issue, ex, those unfortunate people who come down with some damage say to lungs or heart that too soon to know if permanent or not. Yes, this happens to younger people and choice for them as to risk they want to undertake. Do what i want, when i want is nonsensical Libertarian speak when doing so imposes costs upon others, ie the hospitals and healthcare workers.

[Reply](#)**David Landy** November 20, 2020 at 9:08 PM

Individuals shouldn't be ruled by "transmission constraints" and "utility functions". They should have the freedom to make decisions that are best for them.

There are responsible epidemiologists out there, including some of the most preeminent in the world, advising that a strategy of focused protection is the best - see the Great Barrington Declaration. This means simply advising those who are vulnerable to take on certain behaviors and the rest of the population to go about their lives.

[Reply](#)**Mike** November 21, 2020 at 12:52 PM

Great post. One subtle question - isn't it better to push R_0 well below 1? The longer the disease persists the more chance that some kind of negative shock happens. (People get complacent, folks run out of supplies)

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