EconoFact Chats: The Economics of Vaccine Development and Deployment

Michael Kremer, University of Chicago

Published on 12th January 2021

Michael Klein:

I'm Michael Klein, Executive Editor of EconoFact, a non-partisan, web-based publication of the Fletcher School at Tufts University. At EconoFact, we bring key facts and incisive analysis to the national debate on economic and social policies, publishing work from leading economists across the country. You can learn more about us and see our work at www.econofact.org.

Michael Klein:

As of the date of this podcast, there have been about 87 million cases of COVID-19 worldwide, and about 1.9 million deaths with 20% of these in the United States. We have lost over 360,000 of our fellow citizens. Vaccines have been developed and are beginning to be distributed, but the time lag between the onset of the pandemic and the development and distribution of vaccines cost lives. How can we be better prepared for future pandemics?

Michael Klein:

Someone who has been devoting serious consideration to this is my guest today, Michael Kremer. Michael was a co-recipient of the Nobel Prize in economics in 2019. The Nobel committee cited his work on the use of field experiments to combat global poverty and his research spans other important topics as well, such as debt burdens facing developing countries, the spread of AIDS, elephant poaching, and germane to today's discussion, creating incentive mechanisms to encourage the development of vaccines for use in developing countries. Michael, it's a pleasure to welcome you to EconoFact Chats.

Michael Kremer:

Thanks, Michael.

Michael Klein:

Congratulations on the Nobel Prize.

Michael Kremer:

Thank you.

Michael Klein:

I hear that now you've moved to the University of Chicago. If you get the Nobel Prize at the University of Chicago, you get a parking space, is that correct?

Michael Kremer:

I hadn't heard that, but that sounds good.

Michael Klein:

You might want to try to take them up on it, yeah.

Michael Kremer:

Okay.

Michael Klein:

Michael, early in the pandemic, you were one of more than a dozen authors of an analysis that considered alternative approaches to procuring vaccines. And you argued for governments directly funding large manufacturing capacity and taking on most of the risk of the failure of particular attempts to come up with a vaccine.

Michael Klein:

And then in exchange for this support, governments would have the right to buy doses of successful vaccines at little more than the cost of manufacturing them. You also advocated for maintaining some direct incentives for coming up with vaccines quickly. What are the advantages of this approach compared to what we have now?

Michael Kremer:

I think one thing to, really motivated our analysis, was starting out with the imperative of speed. Each month COVID-19 kills about 200,000 people globally. And from an economic point of view, just the short run GDP losses are about $500 billion every month. The full losses are likely much larger. The health costs, the cost of disruption of education. David Cutler and Larry Summers estimate $890 billion as the monthly US cost of the pandemic.

Michael Kremer:

Now, the normal timeline for vaccines takes typically three to four years from initial testing to commercial use and large scale capacity installation. And that large scale capacity installation comes only after the vaccine trials are completed, but that means there's a delay between the vaccine being approved and delivered at scale. So multiple governments and international organizations invested in advance, so manufacturing capacity could be built in parallel with the testing process and so, production could begin earlier. And that's the approach that we advocated.

Michael Kremer:

And I think that early government investment makes sense, because the value to society of making these investments early so we can get the vaccine earlier is huge. Now there's still substantial value for firms, but it's smaller, so they may not invest enough. They may not start the construction of the factories early enough, and they may not build large enough factories.

Michael Klein:

So this is the standard issue in economics, what we economists call externalities, that the advantage to the society at large is greater than the advantage to those who actually engage in an activity. And in this case, the advantage to society is greater than the advantage to the manufacturers and developers of vaccines. What are some reasons that the private value of a vaccine might be lower than the social value?

Michael Kremer:

So, you're right, the vaccines are a classic case of an externality and the classic argument is epidemiological externalities. If I get vaccinated, I'm not just protecting myself, I'm also helping protect other people around me. But if you think about how much I'm willing to pay for a vaccine, that might not reflect the second generation of benefits or the third generation, the fourth generation and so on. Now,

because of that, in most countries, the main purchasers of vaccines are not individuals, but rather governments purchase on behalf of their citizenry.

Michael Kremer:

In this case, in this pandemic case, there's another factor at play, which is their social constraints on pricing, either ethical constraints from the point of view of the pharmaceutical manufacturer or political constraint or the implicit threat of those constraints. And I don't want to say that's a bad thing, there's legitimate different political points of view on what vaccine prices should be, and maybe we do need regulation in the midst of a pandemic. But if we are in a situation where there are either ethical or political limits on pricing, then it may not be in the commercial interest of firms to invest as much in an untested vaccine, as it is in the overall social interest, given the massive human toll on human lives and the massive economic cost every month that the vaccine goes on. Not necessarily the vaccine goes on, but the pandemic goes on.

Michael Klein:

Pandemic goes on, right. Hopefully the vaccine goes on. There are two issues. One is that the vaccine might not work out, it's a risky endeavor to try to do it. And the other is, once it's done, you can't offer the vaccine at a ridiculous, or what people would see as, a ridiculous price. Can you put a dollar value on the distinction between the social cost and the private cost of vaccines?

Michael Kremer:

Yeah, these numbers will be very rough of course, but we estimate that advancing capacity installation for vaccine courses, so that they're available now rather than six months later, is worth about $1000 per course of vaccine. So a lot, a huge amount. And if you compare that to the vaccine prices, there are different prices for different vaccines, but the deal is announced about prices ranging from $6 per course of vaccination to $40 per course.

Michael Kremer:

So if you compare that to the thousand dollars of social benefits, you can see that's really a 40 fold or even a 300 fold gap. So yes, the firms will install capacity, but not as much capacity as society really needs, unless you try to specifically write contracts that encourage them to install more capacity.

Michael Klein:

So, as you were saying, this is like this classic case of an externality, and you're mentioning these contracts that might be a way to get around that. What would the contracts look like, Michael, in order to realize the benefits that you're outlining?

Michael Kremer:

So, I think, let me make an analogy for anybody who's ever hired a contractor to work on their house. You could write a contract that just specifies the work to be done, or in the case of a vaccine, you could write a contract to say, "Hey, we want to buy 300 million doses for the US." The problem is, a dose six months later is not as valuable as a dose now, so society really cares about speed.

Michael Kremer:

And just like if you write a contract for somebody to do work on your house and you don't specify the timeline, there may be various delays that you're subject to. The same sort of problem can arise with vaccines. It's going to be, from a purely commercial point of view, I don't want to cast dispersions on the vaccine developers, they're working very hard. But from a purely-

Michael Klein:

Or on contractors.

Michael Kremer:

Or on contractors for that matter, but from a purely commercial point of view, there are going to be things that may cause delays that may be very expensive to get around those problems. If they build a slightly smaller facility and it just takes them longer to produce, that's going to be cheaper for them than building a larger facility and getting all the production done quickly. So you have to specify that in the contract, or you have to do, say, penalties for being late or bonuses for being fast. Now, the problem with the penalties and bonuses, when it's worth $1000 to society to get it a bit faster, well, you can't put $1000 bonus on, that would be a lot of risk for the government. You can't put $1000 penalty on, because that would be too much risk for the company, especially because there are all sorts of things that are outside of anybody's control that affect the speed.

Michael Kremer:

The length of time it takes to do the trial depends on the rate at which people, trial subjects, are being infected. There could be adverse events that means that the regulatory agencies pause the trial. So in these circumstances, we argue that it makes sense to have the manufacturing capacity to be part of the contract, because that is something, obviously that can be subject to external factors as well, but it's more under the control of the vaccine manufacturers. So could have the contract say, "Look, we want you to start building the capacity on such and such a date. We want you to have it done by this date. We want this much annual capacity." That should be part of the contract. It's still going to be very hard to write a great contract, but those should be part of the contract. And I think that's one of the fundamental insights of this group of economists who worked on trying to analyze this issue.

Michael Klein:

So it's kind of a multi-faceted contract in that way. It's not just the doses, but the speed and the capacity figures and these other things as well?

Michael Kremer:

Exactly. Exactly.

Michael Klein:

So paying for capacity installation transfers the risk from the pharmaceutical companies to the government or the international organizations, if they're the ones now making the contract. So what's the benefit of this for the government and ultimately for the citizenry of a country? Why not just offer to buy the vaccine at a higher price?

Michael Kremer:

So, in general, there are two ways to support pharmaceutical research and in the United States, we use both of them. One is upfront, sometimes called push funded. That goes to fund the research independent of the success of the researcher. So if the national institutes of health makes a grant to researchers at the university, they pay for that and if the research succeeds, great, if it doesn't, it doesn't, but the researcher gets paid either way. The other approach is what we call pull, which is payments that you only get if you succeed. And if you think about a pharmaceutical company that produces a drug, they're investing a lot in the R&D. If they succeed, they get a lot of money, if they fail, well, they don't have a product to sell.

Michael Kremer:

And in general, we think that that mix is appropriate. It makes sense to both push funding and pull funding. Either alone, aren't going to be as effective, but the appropriate mix varies with the situation. And one program that I'd been involved in earlier was something called an advanced market commitment. And that was a commitment that if a vaccine developer comes up with a vaccine that society needs where there's not too much of a market, here we were thinking of something like the malaria vaccine, that governments would commit in advance, that if a vaccine came that met certain specifications, they would help finance the cost of it, so that was a pull contract. In this case, I'd be happy to discuss why we think that this should actually be a pretty big push component.

Michael Klein:

So it's important to both have the incentive for development and to reward success. And as you mentioned in this case, doing just one or the other, wouldn't do the job nearly as well.

Michael Kremer:

Yeah, and let me explain why we think that just relying on a reward for successful vaccine wouldn't have been appropriate, would have been more expensive in this context. It's a somewhat subtle argument. This is a context where, from a social point of view, we want lots of shots on goal. There are a lot of different vaccine developers out there. If you think from the standpoint of Marsh, or we didn't know which one would succeed, turns out we got lucky and a lot of them seem to be succeeding, but we didn't know that back then. If you look historically, most vaccine efforts don't succeed. So from a social point of view, it's worth getting lots of shots on goal, getting lots of candidates in development and actually building the factories in advance for lots of different vaccine candidates.

Michael Kremer:

Now, those candidates, we as the government, as a purchaser, it can make guesses, but it doesn't know what the probability of success is for each. The vaccine manufacturers have some thought presumably themselves about some estimate of the chance of success. If you just said, "We're going to pay a certain amount for a successful vaccine." Then if you want to pull in a lot of different companies, you're going to have to offer a lot to motivate not just the ones that are really confident, but the ones that think they have a realistic shot, but not that big a shot. And that becomes pretty expensive because if you're trying to pay enough to bring in those companies, you're actually paying more than you need to for the companies that are more confident of success.

Michael Kremer:

If you only wanted to bring in the companies that were really, really confident, then perhaps go in with a pull approach, primarily pull approach would have been okay. But if you want to bring in a lot of different companies, and in a case like this, particularly if we're thinking about the cost of manufacturing, that's stuff that the government doesn't know those costs perfectly, but they can ask for the receipts. You need this many bio-reactors, you need this many glass files. You need to build a facility. There's room for some cost inflation there, but it's limited. So, I think, primarily paying through upfront payments makes sense. Of course, you still want some reward for speed, some other things, so some pull component makes sense, but probably the contract should be mostly upfront payments.

Michael Klein:

So, Michael, what would the optimal level of investment have looked like in say, June, July, August of this year?

Michael Kremer:

Right, so we tried to do, this group of economists, some work informally. We tried to do an analysis of that, and obviously there are a lot of assumptions that go into it. We made some assumptions about the cost of the epidemic, taking those from some of the sources I cited earlier, IMF World Bank, US Government sources. We got historical data on the chance of success for different vaccine candidates. We assumed that investing early would accelerate the development of vaccines by three months. If you wait to build the capacity till after testing, we assumed you'd lose three months. We also assumed that there was some chance something else would come along and it would really dramatically cut the toll of the epidemic. And we actually cut the cost of the epidemic by 50%, turned out that didn't happen. But despite doing all those things, we found that high-income countries would invest $150 per person, say.

Michael Kremer:

One thing to notice, $150 per person, multiply that times the US population, that sounds like a lot of money until you consider the cost of the epidemic, which is vastly more than this. So this is a lot more than we typically spend on vaccines, but it's a lot less than the cost of the epidemic. And we called for enough capacity that if we had two successful candidates, we would have had 137 million courses per month and that would have allowed us to finish vaccination by March. Now that would've meant installing some capacity, which some candidates that wouldn't have succeeded, but it would have been worth it when we're estimating this $800 billion cost to the US economy per month. So we invested, but not enough.

Michael Klein:

Yeah. So, I mean, if you did the quick math, and I'm not sure I'm doing this right, but it's what, $50 billion, if it's $150 per person, is that right? And that's not close to the cost that you were citing earlier on.

Michael Kremer:

Yeah.

Michael Klein:

So, compared to what actually happened, one thing that's striking that actually happened is the vaccine was developed relatively quickly. I guess there are new technologies that are allowing that. So compared to what you and your colleagues were looking at, what actually happened with that as a kind of benchmark?

Michael Kremer:

So we had assumed fairly low probabilities of success for each candidate and pretty modest correlations between the chance of success. And what actually happened seems to have been, we got lucky, a bunch of different candidates succeeded. Who knows whether we made the right assumptions? I think we would have been better off if we had invested more, as we've suggested.

Michael Kremer:

But I think the point isn't, did we get it right or not? I think the point is, if you think about this from the perspective of a future pandemic, it's worth doing this type of exercise. And I think what will come out of it, is that we need to be prepared to make very large investments in building up the capacity in advance. I think there are some other lessons, happy to get into them later, about future pandemics. But let me just say, even though I think there are also some lessons from our analysis for the epidemic that we're in right now.

Michael Klein:

So it's hopefully a situation now, where once burned, twice shy, where people are going to be more cognizant of, "We need a medical defense in the same way we need a military defense, because we can be ravaged by it." So I'm hoping that the ideas that you and your colleagues have come up with are things that the new administration and new Congress will take very seriously.

Michael Klein:

If you were to testify on Capitol Hill, a senator or a representative were to ask you, "What are the two or three things that we learned and what are the two or three things that you would advocate our government do, moving forward?" Because it's very likely we're going to face more pandemics. What would you say to them.

Michael Kremer:

Let me start with today's pandemic. There are still enormous gains today to invest in a vaccine. We would have been better off if we built more capacity, even more capacity earlier, but even though there are production lags, even though if we start construction now, there might be a three month lag or even a six month lag. We estimate that installing more capacity now, would have benefits of hundreds of dollars per annual course.

Michael Klein:

Capacity for manufacturing or development of even new vaccines?

Michael Kremer:

For the capacity to manufacture the vaccines that we have. So I think it would make sense, and here I'm thinking partly from a global perspective, the US actually was pretty good relative to other countries in getting a lot of orders in early and getting a lot of capacity in place. But from a global perspective, I think it would make sense to reach out to all the companies and say, "Hey, give us a bid to install more capacity."

Michael Kremer:

And then we would see who can make realistic proposals and shows that they actually have the capacity... And tell us in that bid how quickly you could get the capacity together, how much you would make and obviously, we have the information on the different efficacy of the different vaccines, and let's see if somebody could get more capacity online and ideally in three months, but even in six months, it would still be enormously valuable to the world. So that's one recommendation.

Michael Klein:

And this would be a multi-faceted contract, like you were talking about. It's not just quantity, but speed and other issues, I guess, having to do with the delivery and the distribution.

Michael Kremer:

Exactly. I think what would make sense is to sort of have a request for proposals and have the companies, but for the proposals, of what they think they could do. And then you could order from one, you could say, "Hey, we think four of these bids look pretty good, and we'll order from all four." But to start that process now, we should be doing that right away. A second thing is we should try to get more out of the capacity that we have. And look, some of this is obviously the scientists, the doctors are going to have to make the calls on this. But I think the standard approach that is typically used in the industry and that the

regulators use, which makes complete sense in normal circumstances, is to think about maximizing the benefit to the person who gets the vaccine in their arm.

Michael Kremer:

So you choose the dosage, for example, you're trading off higher dosage might be more efficacious, but it might also cause side effects. Where do you draw the line? It's very subjective, but that's what you think about when you're trying to choose the right dosage. And obviously, with these companies, they didn't know, it's a brand new vaccine. They made some guess, they made their best guess and they test it at that. Well, it's a very different situation in the middle of the pandemic than it is normally. In the middle of a pandemic, if you can save any of that vaccine and use that for somebody else, you're contributing to the faster end of the epidemic and you're contributing obviously to the health of whoever gets that vaccine and to the health of everybody else who benefits from the lower level of transmission in society.

Michael Klein:

So you're advocating maybe a wider distribution of smaller doses in order to prevent the spread more widely, is that what you're pointing to?

Michael Kremer:

I think that's something to consider. Obviously, the scientists have to make the decision, but there are multiple ways you could do this. And in fact, the regulators around the world are considering things like this. So let me start off with sort of one example, which I heard just today, the Biden administration announced they're going to change the policy on this.

Michael Kremer:

So I believe, the original way that Operation Warp Speed was working was they reserved one dose sort of in storage, so they would have the second dose available when they sent out the first dose, just in case there was some disruption to the supply, to make sure that somebody would get that second dose. Well, obviously if you're doing that, you're not going to be able to get the doses out to as many people as you would otherwise. There's some level of risk, sure. If you say we're just going to use, on Monday we have one million doses, we're going to vaccinate one million people, if there's a supply disruption maybe three weeks from now, you're late with somebody on the second dose. But if you can vaccinate more people quickly, that's worth a risk that the Biden administration has just announced they're willing to take.

Michael Klein:

Even the first dose is efficacious.

Michael Kremer:

Even the first dose is efficacious. There are other things that you could think about and another approach would be to say, "Well, let's try a slightly smaller dose." If you went with a dose that's 20% smaller, you could vaccinate 20% more people. And that's something that, I don't think it was 20%, but there was actual uncertainty over what the right dose is. It's not like we know for sure what the right dose is. You can also just spread out the doses more, so instead of giving them three weeks apart, give them three months apart. I believe the UK just decided that it was going to try that approach. Now look, anytime that you do something like that, you obviously have to watch, is that going to cause so much lower efficacy that society as a whole wears off? But that's something you can monitor, you can check.

Michael Kremer:

So let's say that instead of giving them three weeks apart, you give them three months apart. So there's a reason to think that that might actually be a better approach, but you can monitor. And if you start seeing, "Hey, the efficacy is falling off and a lot of people are getting infected after two months." Well then you can reverse the policy, but you'll at least get a chance to try this out and the option of the policy. Again, economists shouldn't be making these calls, this is something that epidemiologists and doctors have to be making the decisions on, but these types of policies should be considered and I think increasingly they are being considered.

Michael Klein:

Yeah, it's important to point out, when you're in the middle of a pandemic, you have to be creative. And as you mentioned, what you would do in normal times before flu season say, is very different from when you have a raging pandemic that seems to be getting worse.

Michael Klein:

So, Michael, I want to thank you very much for the time that you've taken to speak with me today about this most vital issue. And thank you also for your work with others on trying to address this. You bring some good economic reasoning to this really important problem.

Michael Kremer:

Oh, it's been a pleasure. Wonderful to talk.

Michael Klein:

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