HOUSE OF COMMONS

Science and Technology Committee

Oral evidence: UK Science, Research and Technology Capability and Influence in Global Disease Outbreaks, HC 136

Friday 5 June 2020

Ordered by the House of Commons to be published on 5 June 2020.

Watch the meeting

Members present: Greg Clark (Chair); Aaron Bell; Dawn Butler; Chris Clarkson; Katherine Fletcher; Mark Logan; Carol Monaghan; Graham Stringer; Zarah Sultana.

Questions 758 – 821

Witnesses

I: Professor Carol Propper, Professor of Economics, Imperial College London; Professor John Kay, Economist and Fellow in Economics, St John's College, University of Oxford; and Professor James Poterba, Mitsui Professor of Economics, Massachusetts Institute of Technology.

II: Professor John Loughhead, Chief Scientific Adviser, Department for Business, Energy and Industrial Strategy; and Philip Duffy, Chief Scientific Adviser, Her Majesty's Treasury.

Examination of witnesses

Witnesses: Professor Propper, Professor Kay and Professor Poterba.

Q758 **Chair:** As part of our inquiry into the handling of the coronavirus pandemic from a science and research point of view, we are considering this afternoon how the economic consequences of particular decisions affect outcomes, including health outcomes.

We are delighted to have three distinguished applied economists in our first session and, in our second session, the chief scientific advisers to the Department for Business, Energy and Industrial Strategy and the Treasury.

Before we begin, I should put it on the record that I am an honorary fellow of Nuffield College, Oxford, where one of our witnesses, Professor Kay, is a visiting fellow. I ask members of the Committee whether they have any relevant interests to declare that are specific to this meeting. That is not the case, so we will proceed with the first panel.

I am delighted to welcome our witnesses. Joining us from the United States, we have Professor James Poterba, Mitsui Professor of Economics at the Massachusetts Institute of Technology. He is president of the National Bureau of Economic Research in the USA.

We have Professor Carol Propper, Professor of Economics at Imperial College London and president of the Royal Economic Society here in the UK.

We have Professor John Kay, Fellow in Economics at St John's College, Oxford.

Thank you very much indeed for sparing the time to help the Committee today.

The Committee has heard over the past few weeks from scientists advising the Government, including epidemiologists, clinicians, microbiologists, behavioural experts and others. What are your views, Professor Poterba, on the relevance of economics and its related disciplines to the determination of policy in handling this pandemic?

Professor Poterba: Let me start by saying thank you very much for inviting me to testify before this Committee. As someone who had the great good fortune to spend my graduate studies in Oxford, financed by the British taxpayer through the Marshall Scholarships programme, I have always been incredibly grateful for that. I certainly could not pass up an opportunity like this to give something back, so thank you for having me this afternoon.

I think there is a growing understanding that economics and epidemiology go hand in hand in thinking about the response to something like the Covid-19 crisis. Economics is about making marginal trade-offs and trying to understand the costs and benefits of particular actions. I think we are coming to a more nuanced understanding of policy

options than we had even three months ago. In particular, some of the most recent research that has been done suggests that more targeted strategies for shutdown, or restricting interaction within the population, can be very effective in reducing loss of life while having a somewhat smaller economic cost than broad-based shutdown. A one-size-fits-all policy can be a very blunt instrument.

There are two dimensions on which recent work has been focusing: trying to understand how different age groups, given their different susceptibility and apparently quite different mortality rates associated with the virus, might be protected in different ways; and strategies that could, for example, focus social distancing and other types of segregation on the older population, which seem to show great promise as a way of reducing the economic cost of policies that could be pursued. This may be more relevant to reopening than it was when we knew less about it in the shutdown.

Similarly, across the economy, different sectors have very different impacts on virus transmission. Today, we have a language for thinking about that in focusing on the viral retransmission rate, sometimes referred to as the R factor. Just in the past few weeks estimates have emerged in the US that point to the amount of economic activity generated by different industries relative to their impact on the viral transmission factor. Occupations like software engineer, barrister or financial adviser working in relatively little interactive settings have relatively high value in comparison with the amount of retransmission, whereas the retail or hospitality sectors fall at the other end of that spectrum. That is not saying anything that we would not have guessed before, but we are beginning to see evidence that enables us to try to calibrate how much one can allow some of those high-value but low-retransmission sectors to reopen without putting at risk the broader population.

The other thing we are realising is that a lot can be done. Activity that reduces economic interaction and policies that reduce social interaction are in many ways, to some degree, substitutes. If you can shut down enough of the weekend interaction, you may be able to allow a bit more interaction in the workplace, while at the same time managing to keep the viral retransmission rate relatively low, or at least at an acceptable level. Those are some of the key insights on the trade-offs that economics can highlight as we think about some of these issues.

Q759 **Chair:** You said at the beginning that some of these had health consequences. Sometimes the consideration of economic factors is thought to be a trade-off between lives and pounds, but will you say a little more about how it can be about lives and lives, as it were?

Professor Poterba: There are some situations in which there are policies that can be attractive on both life-saving and economic activity. I give a simple example. I am not completely certain that the underlying numbers and parameters are worked out, but imagine the following

scenario. Let us say you could take the very high mortality risk group, the 65-to-70-plus age population, and literally keep them by themselves so they did not have any contact with the rest of the population, and you allow the rest of the population at lower risk to interact until the point at which you manage to get essentially herd immunity in the younger group. We know that herd immunity, once you get there, can be very helpful and you can begin to reopen at that point, but if you can split the herd and manage to let the high infection rate play out with a low risk of fatalities or other adverse consequences and think about allowing the herds once again to come back together, you can end up with a policy where the economy is moving along for a period of time.

You could build herd immunity at some cost. There would be some loss of life along the way, but it is more modest than would have happened had the whole population been interacting. When you reopen fully, you end up with a lower overall loss of life and potentially significantly higher economic activity along the way.

That is an extreme case to motivate the point but, in general, the notion that there are trade-offs here and that they need to be thought through is an essential piece of the problem.

Q760 **Chair:** Professor Kay, on the same theme, what role would you expect economics to play in policy decisions relating to Covid?

Professor Kay: I think Jim has made the key point, which is that economists are used to thinking in trade-offs. There are trade-offs all over the place in this, both lives against lives and lives against cost. Indeed, costs have impacts on lives. To give a pretty forceful but rather unpleasant example, a lot of people are dying as a result of this, but there is one value to be attached to the death of a nurse aged 25 and a rather different value to be attached to the life of someone in their 80s in a care home. Bluntly, decisions about policies involve trade-offs between one and the other.

Similarly, we know there will be trade-offs in important operations that are postponed as a result of the virus, so lives will potentially be lost later. Therefore, it is lives against lives in a whole variety of ways, and these trade-offs need to be made. They are very unpleasant, but it is really your job as politicians to make them.

Q761 **Chair:** As you say, they are not just difficult trade-offs to contemplate politically, but one would have thought they are also difficult for practitioners involved in some of these decisions. It is not just policy makers.

Professor Kay: Yes, indeed.

Q762 **Chair:** Professor Propper, you have done research into some of the consequences of the economy for health. In some research you did in April you estimated—I think I quote you accurately—that a 1% fall in employment leads to a 2% increase in the prevalence of chronic disease.

What is the basis of that estimate, and what are the implications for the subject we are discussing today?

Professor Propper: Thank you for inviting me. We have been looking at the impact of recession on people's health. We know that Covid is about health, and what we have engendered by having lockdown in many countries is essentially a recession.

Therefore, the question is: what effects do recessions have on health? To answer your question, the first thing is that not all recessions are the same, and exactly what type of recession it will be decides whose long-run health will be most impacted.

We do not yet know about this recession, but several recessions in the past—less so the 2008 recession—affected the young particularly. We know from a lot of epidemiological and economics research that one group that is very badly affected by recession is the very young: children born during recessions and children who are very young during recessions. Those recessions cast a long shadow over their lives. Indeed, children born in very severe recessions can live a considerably shorter life, let alone the quality of life, than children not born in those periods. I think the current recession, which at least at present is hitting young people particularly badly—young people are parents—is likely to have an impact on their children.

The other group that is particularly vulnerable in recessions includes individuals who are in danger of mental unwellness or mental ill health. It has been shown consistently during recessions that what tends to rise is quite often suicide rates but, more generally, mental health problems. We do not know exactly how Covid will play out when we are all locked down, but when we come out of lockdown there will still be some groups left in lockdown, for very good reasons, and it is quite likely they will suffer from mental health problems.

Those are the kinds of chronic problems that can manifest themselves over quite a long run. They do not occur immediately; they take some time to build up.

The final thing is that the research we have done tends to suggest they are concentrated in particular areas. Not only are they concentrated among groups who are more disadvantaged, but those more disadvantaged people tend to be concentrated in particular areas, leading in some cases to what Case and Deaton in the US have called "deaths of despair": communities in which there is very little work because of economic conditions, leading to people taking their own lives through substance misuse or in some other way.

Chair: Those are important themes that we can take up throughout this session.

Q763 **Graham Stringer:** Professor Kay, may I ask a fundamental question?

What use is economic forecasting to policy makers? Mervyn King, the previous governor of the Bank of England, used to say when he made forecasts that the one thing he could be certain of was that they would not be accurate. Is economic forecasting valuable in forming policy?

Professor Kay: You might know that I have just published a book with Lord King, *Radical Uncertainty*, which is sceptical about the use of economics and forecasting of these kinds. You may know that when he was at the Bank of England he introduced what he described as fan charts in the Bank's forecasts, in which he talked about getting away from a central point forecast of what he and his colleagues at the Bank thought would happen to express upper and lower bounds of what was possible.

He emphasises that that is a way of pointing out that any economic forecast is subject to margins of uncertainty, but that raises questions about where these estimates of bounds are derived from. He and I had long discussions on that.

It is a bit like weather forecasting. A lot of people disparage it, but it is not too bad. If you look on your phone, it will probably say there is a 50% chance of rain tomorrow. What I think that should mean—the Met Office gives a rather complicated description of what it means—is that, when experienced meteorologists say this, on 50% of these occasions it does actually rain. Economic forecasts should be interpreted in the same way. I do not think economists are as good at it as meteorologists, but that is what they ought to be aiming for.

Q764 **Graham Stringer:** I agree with you. I do not think they are as good as meteorologists. They sometimes get the direction wrong. Before the referendum on whether the UK should remain in the European Union, the Office for Budget Responsibility said there would be an immediate recession if the country voted to leave. Until the Covid crisis there was fairly steady growth and increasing employment. Does that come within the realms of your "probably this will happen, or possibly this will happen"? That was completely the wrong direction. They were not alone; a lot of other economists shared that view.

Professor Kay: As we say in the book, economic models tend to work pretty well as long as nothing much changes, which does not help them to be a great deal of use. What really matters from this point of view is understanding the nature of the underlying change. For example, the 2008 financial crisis was not and could not be forecastable, in the sense that if one had known this was going to happen there were things that could, should and would have been done to avoid it, or at least to avoid it in that particular form. What was missing in the run-up to the 2008 crisis was a proper understanding of what was going on in the market for mortgage-backed securities and other complex financial instruments. If there had been better understanding of that, people would have been better prepared for such a crisis and better equipped to deal with it when it came.

Graham Stringer: You have probably sold me on your book. I will go and get a copy.

Professor Kay: It is a good price at the moment.

Q765 **Graham Stringer:** However accurate the forecasts, they depend on the accuracy of the statistics being used. Are there any obvious gaps in data collection at the present time that could be improved?

Professor Kay: There are very large gaps right now in relation to the analysis of what is going on in this crisis. One of the best things that has happened in the past month has been starting this exercise in which ONS collects data on the number of people who have this infection and those who have acquired it. If we had had data of that kind much earlier in the crisis, I think we would have been able to make much better forecasts than the ones we were able to make.

The general point to be made is that our economic data collection and national accounts framework originated in the second world war, when manufacturing was a much larger proportion of economic activity than it is today and when we wanted to know what resources we had in order to fight. I do not think we have changed the ways in which we collect and analyse data enough since then to reflect the ways in which the structure of the economy has changed, where most of our economy is now focused on services of various kinds and manufacturing is a relatively small part of it.

In my view, the use of economic models and other models is not so much to make predictions as to give people better insights into what is going on, and that is the way in which models ought to be used.

Q766 **Chair:** You wrote in pretty robust terms about the lack of available data. You said that the greatest scandal of this epidemic is the delay in undertaking widespread testing and that the cost of obtaining good economic and epidemiological information is trivial compared with the costs of bad policy made in its absence. Why do you think we were so late in equipping ourselves with the data to inform decisions?

Professor Kay: I think that will be a major subject in your investigation and you need to pursue it particularly with people at Public Health England—I think you have begun to do so. My strong sense is that there was an insistence on centralisation of the process of testing and monitoring testing, which both delayed its introduction and limited capacity. For example, there were and are many university labs that have capacity to do this kind of work. If they had been both allowed and funded to do it, that would have enabled us to ramp up testing capability much more quickly than was done.

Q767 **Chair:** You referred to models providing not necessarily a reliable forecast but an understanding of the factors at play. Economics and epidemiology perhaps share this in common: they involve a lot of model building. In the context of the University of Oxford, do you have

conversations with epidemiologists? Is there a shared understanding of the lessons that economic modellers perhaps have for epidemiology, and vice versa?

Professor Kay: I can answer that very briefly by saying no. There is almost no such contact. People develop models for their own academic subjects with very little connection to the kind of models that are developed in other subjects. As I think you are aware, there is a kind of silo-ing of academic life nowadays, which means there is nothing like enough sharing of knowledge of this kind and experience across different subjects.

Q768 **Chair:** I do not want to put words in your mouth, but do I detect an implication that we should try to overcome that silo structure?

Professor Kay: You do detect that implication. One of the interesting things we picked up in the book was an example of the ways in which models can lead and mislead. The Imperial College team to some degree made its reputation 30 years ago by understanding that a very simple model of the spread of AIDS was better than the very complicated WHO model. It focused on the idea that it was not the number of sexual encounters people had that was key to the spread of the disease; it was the number of different sexual partners. That was why, as things emerged, it was in the gay community and certain societies where promiscuity was very common that AIDS spread very rapidly, whereas in other countries and places it did not. A model that focuses on the key parameters is a lot more useful than a more complicated one that tries to bring in everything.

Q769 **Chair:** It is not the mathematical complexity of the model; it is the sharpness of the insights on which it is based.

Professor Kay: That is exactly right. It is both the insights on which it is based and the insights that you take from the model in understanding what the parameters are.

Q770 **Chair:** Perhaps we could have an international perspective on this question from Professor Poterba.

Professor Poterba: I would share John's assessment that there was too little interaction between the epidemiology and the economics communities, although there has been in the past three months a remarkable amount of cross-disciplinary discussion at least as economists have tried to embrace and build on the epidemiology models. Many in epidemiology and in the health services area have realised that the economic cost of some of the policies their models suggested were very important to understand, and consequently they have become very concerned about building some more economics into those models in various ways.

I should respond quickly to the question about the uses of models. I certainly agree with John and Mervyn King, who was one of my

dissertation supervisors, on the challenges of working on models for forecasting purposes. It is important not to lose sight of the fact that they can often provide very substantial guidance on understanding the consequences of policies. For example, if in March you had asked which parts of the workforce would be most dramatically affected by a systematic shutdown of the economy and social distancing, with relatively high confidence we could have said that lower-skilled workers engaged on the frontlines of retail, hospitality and delivery were the ones who would have challenges working from home and that they were not going to be able to operate in the virtual environment.

To link that to what Carol said a few minutes ago—the consequences for them of the economic shutdown, the potential health consequences and other things—those were things that you could call a model, but I would say it was simple data analysis informed by some thinking about how the economy operates, which would have given you some pretty good insights into those issues and their consequences. It would not have given you the capacity to forecast with high confidence exactly how many jobs would be lost, but I think we would have got some valuable lessons there.

On the general question of the role of economics, the other important point to remember is that it is about individual choice and behaviour. We have some clear evidence in this crisis that individuals responded to information about what was happening in the broader world even before policies forbade them from undertaking different actions.

The data I have seen from OpenTable, which is an online restaurant booking service here in the US, suggests there was a very sharp drop-off in restaurant bookings a week or more before the shutdowns took effect in most US states. Almost no one in New York City was booking a restaurant meal two weeks before the city actually closed down. That suggests people were trying to form judgments about the information available to them and the risk that they faced.

As for whether those are perfect or imperfect, we can do research and debate that for years to come, but the basic observation one needs to build into the framework—individuals and firms will take actions based on what they perceive as costs and benefits—is very important. That is another piece of the insight from economics that I think is very important not to lose sight of.

Q771 **Carol Monaghan:** Professor Kay, perhaps I may first make a point rather than ask a question. You said the 2008 crash could not have been predicted. Of course, that could have been predicted when people were being given mortgages that were seven times their salaries. A dog on the street could have said something was going to happen there.

Covid is a bit different. One of the issues is that the forecasts have been so vastly different. We have had models about a certain number of deaths; other models tell us a different number. As we look to economic

recovery, the important thing for Government is to use the best possible modelling. Modelling is always based on some suppositions at the start. May I ask about the uncertainty that is built into these models? How can we decide which models are better for following and developing policy than others?

Professor Kay: Can I start by picking up your point on the 2008 crash? You are absolutely right. I will take you to things I wrote before 2008 that said this would end in tears, but how it would end in tears and when was not something you could predict. I certainly did not realise—few people did—that much of the low-quality paper that had been generated would end up in banks themselves.

More generally, there was uncertainty of that kind about the 2008 crash. Both that crash and Covid are examples of what we call in the book radical uncertainty. We say in the book that we will be hit one day by a pandemic generated by a virus that does not yet exist. We did not know that it would exist at the time the book appeared in bookshops.

Q772 **Chair:** You have not retrospectively edited the text, have you?

Professor Kay: No, but I think that when we write a preface to the paperback edition we will highlight that particular point. It was not written with hindsight. We did not shove it in at the proof stage.

To go back to what I said earlier, we can use models to identify the key parameters that we need to know. The epidemiological models here are good examples. People realised quite quickly that R, the reproduction rate, was critical to understanding what was going on and how this pandemic would develop. The suggestion that that number was quite high led to some of the panic about the way in which the virus would evolve, but the analysis can be only as good as the data on which it is based. As I said earlier, the data on which the models were based was very poor.

Q773 **Carol Monaghan:** How do we get the right models? The next few years will be tough, so how do we choose the ones that are going to be as close to reality as possible?

Professor Kay: I do not think you will get a model that gives you an accurate prediction. The Met Office says there is a 50% chance that it will rain tomorrow. That is the opinion of experienced meteorologists who have been right about these things and whose judgments have been relatively good in the past. I think that is the way in which you ought to choose between models. You should choose between modellers rather than the models themselves.

Q774 **Chair:** Professor Propper, on the question of whether models should be relied on for specific forecasts, or used principally to understand what is going on, as president of the Royal Economic Society here in the UK you have a good perspective across the board. What are your personal reflections on that?

Professor Propper: I would endorse what someone as eminent in this field as John says. In thinking about Covid and its responses, we know this is a complex problem in which we have had a health shock leading to an economic shock, which has led to different people responding in different ways.

When we think about those models, I would prefer to think about the trade-offs one needs to make and what might inform those trade-offs. A classic example is that it is fine to open schools, but if all parents are either too worried to send their children there on public transport because no clear messages are being given about safe distancing on public transport, or they cannot send their children because only one year is going back and they have three children and two others to look after, they are not going to send those children back. Simple models in which you open a school and suddenly open all the workers who are the parents of children in those schools do not work. You have to take into account how people respond to the messages they are being given. Jim's point about messages is really important.

Covid has been an international pandemic. In Britain, we have seen responses taken earlier by other Governments and people can see them happening. They therefore take responses as they do in the US, which was late to lockdown compared with other countries.

We have exactly the same thing going on here. We have people observing things happening round them. One of the problems is that we do not really have that realtime data matched to administrative-type data.

To give one more example of the need for that data, when we shut down hospitals we did not realise we would have a 50% drop in A&E attendances. Clearly, that has been accompanied by some people who should not have gone to A&E not going to A&E, which is good. On the other hand, some people with things like heart attacks and minor strokes, who should have gone to A&E, did not go. We did not anticipate that, and we have no realtime way of tracking it.

Chair: That is a very important observation. I think the theme about the more up-to-date data the better is one we have heard throughout our sessions, and it is interesting to hear it here.

Q775 **Chris Clarkson:** I would like to go back to a comment made by Professor Poterba. I ask him to flesh out what he thinks about using epidemiological information—for example, knowing how many people have had Covid-19, which people have had it, in which parts of the country and in which sections of society—to make more reliable estimates about the shape of the economic recovery. Beyond that, is he aware of, or can he give us details of, examples where economists and epidemiologists are working together to make more reliable models?

Professor Poterba: In helping to inform the economic circumstances or sharpen the economic forecasts, one of the great challenges when people ask economists today whether the recovery is going to be a V, a U, an L or a swoosh is that a great deal will depend on whether we have a second wave of Covid cases when we get into the fall or winter.

If one looks back to the Spanish influenza in 1918, there we had a triple peak. The initial bout of Spanish flu, at least in the United States, was relatively modest. The second wave the next year was deadly and caused complete chaos, and the third was more modest again. I am not going to say it is just epidemiologists, but if the medical community could predict what is going to happen with Covid reinfection rates, conditional on the level of social interaction and other things, I think we would be in a better position to be able to describe what the economic outlook might be. It is the intersection between these two that is really important.

The place in which the interaction between epidemiology and the economics is most evident, at least from where I sit, is that the economists are trying to build models in which they can explore the consequences of various targeted policies, as I described at the beginning. A crucial example takes us back to what Carol said about opening schools. A crucial set of parameters to think about is when you are trying to do a targeted policy that is attempting to keep the highest-risk part of the population safely off the grid and allow the rest of the economy to start to interact again. What is the nature of the interactions between different age groups within the population?

That is not the kind of data on which we typically collect a great deal of information. What we have tried to do is to find—some of my economist colleagues have been doing this—any information that captures data on the number of times during a typical day or week when a seven-year-old encounters a 70-year-old. That is what we need to be able to figure out if we are opening schools. Is the interaction in the school going to flow back in and contaminate the older population, where, once you get exposure, it is very high risk?

We have some information to suggest that most of the young population interact with the young and middle-age population, but there are some cases where grandparents are caring for their grandchildren. In those cases you have to be concerned that perhaps an alternative policy would be needed. That is a place where the sociology, epidemiology and the economics all come together to say, "We need to measure some things we have not measured historically. Once we have those measures, we need to build the models that will enable us to use those, and then we need to think about what the policy implications will be."

As Carol said, we have to think about the employment and economic effects of reopening schools. Those who have one child whose grade is open can go back to work; those who have three cannot; and those who have three but also have grandparents living in the household may have

a different kind of support network, but maybe we need to be paying attention to their rather specialised circumstances and, if we are trying to minimise fatalities, not allow that household to open up in the same way as others. I think there is the beginning of a real attempt to do this.

There is one other thing on data that I would mention in contrast to what we saw in 2008 in the financial crisis. These are different experiences. In 2008, it took a long time for the research community to begin to step up and find ways of tracking what that crisis was doing in social, health and employment areas. Just 12 years later, we are in such a different world with data collection and the digital economy. For example, within economics, researchers are now using cellphone GPS data to figure out how likely it is people will be going from one place to another, and to track inter-regional transmission. They are beginning to track realtime information on online access to see who is working from home and who is not; they will be able to check Google searches to see how many people are searching for "lost my sense of smell and taste", to see how many people think they are potentially at risk of having Covid. An enormous amount of information has become available.

At the same time, at least in the US, agencies like the Centres for Disease Control and Prevention and the Centres for Medicare and Medicaid Statistics, which track our elderly population's healthcare utilisation, are being pushed hard to make data available more quickly for the research community. I think that is another dimension. There is a question about the timeliness of data. Even if the information is collected, in many cases it takes a long time for it to reach the point at which the research community can work with it. In a situation like this where we have not been tracking a lot of the key metrics, getting the realtime data available to researchers is absolutely critical. That is crucial if we are to have this favourable feedback loop where the researchers can inform policy and collect more data on things as they are moving forward.

Q776 **Chris Clarkson:** Thank you very much for an extremely comprehensive answer. Will you flesh out the concept of uncertainty, which Carol Monaghan talked about? How well do we understand the interaction between the economic recovery and health impacts, and how do we factor in those uncertainties?

Professor Propper: Perhaps you would clarify your question a little. Are you referring to the uncertainty about the current position and how it will affect people? Clearly, it does; uncertainty makes people anxious. We also know from behavioural literature that how people respond to big shocks and risks tends to vary quite a lot. For example, people who have been in things like tsunamis follow that by taking more risks. You would think they would take fewer risks, but they take more.

Quite a lot of the work on how people respond to uncertainty, driven by psychologists and economists, is based on lab-based tests and randomised control trial-type situations, so how people respond to it can

be quite difficult to generalise from some of that research evidence. Does that get to your question? I was not quite sure what you were asking.

Chris Clarkson: That is pretty much what I was looking for.

Professor Poterba: Mr Clarkson, perhaps I may quickly offer another take on what Carol said earlier.

Every one of these crises is to some degree different, and it is particularly true in thinking about the health-economic interlink. While many of the effects she identified about what we call deaths of despair and the lack of economic opportunity translating into morbidities and mortality are well known to be important things, there are also things about an active, high-pressure economy that cause deaths to occur. There are fatalities as people are commuting to work; there are occupational fatalities at work—for example, on construction sites and other places. There is evidence in the United States that mortality seems to be higher in periods of strong rather than weak economic activity. The point is that it depends on why the economy is strong and what is going on.

One of the places where the link between mortality and the economy seems to arise, which was very perplexing when it was first found, is care homes. There is higher mortality in care homes during strong economic times. That is certainly not people going to work and certainly not people involved in occupational fatalities. There was some suggestion it was because when the economy is strong it is harder for care homes to recruit workers, and consequently the quality of care being delivered in those homes may decline, which redounds to the detriment of their residents.

The care home aspect of this crisis is clearly a very sad story, and we will need to devote a great deal of attention to it looking forward. In the United States, close to 40% of the Covid fatalities have occurred in care homes. I think that has totally blind-sided many people in public health as well as in the economics community, so it is a place where more data collection and research will surely go on.

Q777 **Katherine Fletcher:** I will start with Professor Kay, but I would welcome Professor Poterba and Professor Propper popping in.

Back in the financial crisis of 2008-09 I had quite a stinking argument in a pub, as all the British do, with an actuary asking when economic models were going to take account of the human condition and human behaviour at its most simplistic level. For example, in the financial crash, nobody was modelling the likelihood of change of short-term actions based on human greed. How the paper ended up with the banks probably has something to do with that.

I appreciate you cannot put a number on that, but in the fan diagram world you can assign probabilities of what percentage of any given population is engaging in the negative behaviour that we may or may not call greed. The reaction I got from that individual was, "Nonsense, Katherine. It's just about the raw figures; it has nothing to do with

people; it is all about the models."

I wonder whether yet again we are looking at a system where we almost see an overlay. Twenty per cent. of people are afeared so much for their personal health that they will not take any action from the Government, and 20% of people are blasé enough to want a group of eight jumping out of a plane. Can you give the Committee any confidence that we have economic models that will allow for that?

Professor Kay: I do not think I can give you that confidence. I go back to emphasise a point that Carol has made in several of the things she said. One of the reasons economic modelling is difficult and unsatisfactory is that it does depend on human factors. When the Met Office forecasts that there is a probability of rain tomorrow, the weather is not affected by that forecast. Equally, the weather does not care whether or not I am carrying an umbrella.

Neither of these things is true in the world of economic modelling. Forecasts do have an effect on people's behaviour, whether the forecasts are right or wrong, and the way in which people respond affects the structures of the model. That is why economic modelling will probably never be even as good as weather forecasting, but we have to build in these things. People are doing work on that and understanding rather better the ways in which people respond to this kind of information.

I think we are making progress. We are not making very much progress, but we are learning more about the way in which the human behaviour of real people affects economic outcomes, and I think—

Chair: We are losing the sound a bit, Professor Kay.

Professor Kay: I was going to say that recovery is also very much affected by Government policies, which again is an input into the model that is not needed when you are modelling a physical process like the weather or, to some, epidemiology.

Chair: The Committee has a session next Wednesday on epidemiological modelling, so some of this discussion will be relevant to that. We do not have much more time, so let us keep it on the current pandemic.

Q778 **Mark Logan:** I have two questions for our witnesses. The first one is in two parts and I will try to be quick. This one is for Professor Poterba—others please jump in.

Different approaches to releasing the lockdown measures have been suggested—the professor mentioned this earlier—including releasing, first, restrictions on younger people or high-priority sectors. From an economic perspective, what approaches do you feel seem most feasible? The second part to that question is: what is the evidence for these approaches?

Professor Poterba: The general point that going all or nothing is likely to be dominated by a factor that does something in between is the

easiest claim to make, and that is the part I begin with. Something that recognises that some parts of the population and some parts of the economy are at much greater risk of bumping up the retransmission rate when they are open rather than when they are shut down is the starting point here.

Having made that platitudinous comment, how do you get from there to actual recommendations on what we do? This depends a great deal on being able to do the measurement and understand the consequences of opening different sectors or allowing different groups out. It also depends very much on Ms Fletcher's question about whether people comply and how you think about the role of human behaviour in all of this. One of the things we have been finding with some of the data science, emerging at least in the US, is that not everyone complies when they are told to shelter in place or stay at home. Those compliance rates vary by groups. By and large, the elderly tend to do it; the young are less compliant. It also depends a bit on everything from political beliefs to education and economic circumstances. This is a complicated matrix that one needs to try to fill through.

I am not sure I have a simple answer for you in terms of what to do. At this point the United States is collecting a great deal of state-level information as different states reopen at different points to different degrees. The early evidence is that the direction of what the models suggest seems to be borne out; in other words, states that have opened a lot and early are seeing a bit more of an uptick in the number of Covid cases than those that have proceeded on a more measured basis.

Professor Propper: In the UK context, not only will it vary across sectors and people, but because they are not evenly spread across the country it will vary across the country. There is quite a big case for thinking about different regional and local areas doing things, but that means you have to have things like CBI in place at local level. It is very clear from responses to Covid that we need local knowledge to feed in to help us make the best of the recovery while not allowing R to rise.

Q779 **Mark Logan:** How can the Government best incentivise or encourage people to adhere to new rules?

Professor Propper: People get information from everywhere and they discount information, as Jim Poterba said, by how much it costs them to respond to it. We know that is quite subtle. When you move from a really simple message like "everyone stay at home", you have to tailor the message towards different groups. There is quite a lot of behavioural economics from the behavioural information unit running at the Cabinet Office about how best to tailor that information. We need to think very seriously about taking on that research to understand how to tailor a more nuanced message.

Professor Poterba: That is exactly right. There are two basic approaches you can use. You can try to enforce high fines or penalties for

people who have not done what they are supposed to do by group. That is very difficult to do, and in societies like the United Kingdom and the United States it is potentially unpalatable, or you have to have clear and believable messaging from leadership that seems to be conveying information that needs to be taken seriously. Here in Boston, which has been a relatively hard-hit city in this crisis, fortunately we have had clear messaging from our state-level leadership. That has been very helpful in getting people to comply voluntarily with mask wearing and other things like that.

Q780 **Zarah Sultana:** My question is to Professor Kay and Professor Propper. We know that the UK has the most absolute excess deaths in Europe—almost 62,000—and the second highest rate per million people, falling behind only Spain. When we look at the number of deaths globally, we are behind only the US. It is rising by more than 100 a day and there are thousands of new cases per week. The reproduction number, R, is only just below one at the moment, with reports today that in the north-west it is above one. SAGE members are concerned that we are easing restrictions in England specifically far too quickly. Are there similar concerns within the economics community, and from an economics perspective what do you feel about this?

Professor Kay: My starting point is that we should be very careful about interpreting all this data. I have spent a fair part of my career—I think my economics colleagues have as well—asking questions about where the data comes from and how reliable it is. Very often, when you think you have a surprising answer, it is because the data or analysis is wrong rather than because the answer is surprising. I am not sure we yet know how the UK compares with other countries in terms of excess deaths, or indeed how excess death figures should be calculated to give meaningful numbers.

You say that the R number may be rising and may be above one in some places. I emphasise that I do not think there is any single R number. There are R numbers that differ across groups and places, and we need to take account of all those things in analysing it.

I find the latest numbers from the ONS random sample data, which is probably the best information we have on what is going on, quite encouraging, but it will need more analysis before we can really interpret what is happening.

Professor Propper: When we do the analysis, it will probably be the case that very densely populated countries that have very heavy reliance on public transport will be those in which Covid-19 had a big impact, because we know it is a disease in which indoor transmission is really important compared with outdoor transmission. Countries in which people drive to work predominantly and are alone in their cars and have structures in which work is relatively well spaced will have had less. Those are very complicated sets of things before we can say that Britain has done badly.

I would like to echo something John said. We know that R is much higher in hospitals and still in care homes, which have been and still are woefully neglected, than it is in the community. One of the points we are trying to make is that averages are not terribly helpful to you when you are trying to come out of this. A single lockdown is a single average, but, if you are trying to come out of that to balance the lives versus lives issue, you are beginning to look at sub-groups and areas where R may be lower than in others and groups where R may be lower than in others, or where R may have less effect, which is the point Professor Poterba is making all the time. While R may be high in children because they cannot socially distance, the impact of it is small because the people to whom they are passing it, on average, do not have large effects from getting it.

Chair: We will have to speed up because we are running out of time, which shows the interest we have in the witnesses.

Q781 **Zarah Sultana:** Linked to that question, how do you feel economic approaches complement scientific ones to fine-tune lockdown measures both where measures are lifted and where restrictions might need to be increased further if there is a second wave or conditions change?

Professor Propper: There is scientific uncertainty and there is uncertainty within the social sciences and economics community. It is not even the models. The more we can put these ideas together, the more we can get as much realtime data as possible and get health authorities to release health data, which is very difficult to do on a timely basis, the faster we can begin to analyse and build scenarios to get us out of lockdown quickly. It is all about having data and ideas and sharing both.

Chair: I know Professor Poterba has another appointment he needs to go to. I promised we would not make him late.

Q782 **Aaron Bell:** My economic training taught me two things: that people respond to incentives and that there are trade-offs at the margin. It is good to hear three distinguished professors remind me of that.

Professor Propper, on that note, what do we understand about the cost-effectiveness of the public health measures we have taken so far? We have talked about medical effectiveness, but what about cost-effectiveness?

Professor Propper: It is very hard at this stage. I know that cost-effectiveness is probably often at the heart of this Committee. It is very hard to talk about it. In order to contain Covid and prevent what happened, for example, to the health service in Lombardy, which is a well-financed health sector, we absolutely threw resources at dealing with patients with Covid. We have no idea what the costs are even for the patients we have not treated and for those who have not turned up. I do not think we are anywhere near cost-effectiveness studies. I know that is not a great answer.

Q783 **Aaron Bell:** I understand there are some practical limitations. In terms

of traditional measures, such as quality-adjusted life years, are they appropriate in this context? We have talked about excess deaths and the issue about the timeframe in which you look at it. Do you think quality-adjusted life years is the right metric to be looking at?

Professor Propper: For those, it is basically about how soon you die. There are more societal trade-offs. Those are very useful for thinking about whether you should introduce a particular drug now. NICE uses them very nicely. I do not think they are designed for pandemics, where you are making all kinds of trade-offs between different groups. That has political and social aspects. People want to value some people more than others; people want to value their elders dying in dignity with people around them. This has almost too many tentacles to put them all in boxes. You can think about the trade-offs. Reducing them all to QALYs would be nice in theory but impossible in practice, and it requires political decisions that QALYs are not designed to make.

Q784 **Aaron Bell:** May I briefly ask the other two witnesses a little about the overall role that economics has played in guiding the rationing of resources? Do you think there are points where the judgments economics would make differ from medical judgments, or is it along the lines of what Professor Propper has just said: we will start with the medical emergency and take the economic judgments later?

Professor Kay: The economics and the epidemiology have to be linked together. People have talked in this crisis and in some others about, as it were, the science and being guided by scientific advice. I do not think scientists, any more than economists, can give advice in that sense. What we with expertise in particular fields ought to be able to do is frame some of the issues in ways that enable policy makers to make the very hard choices that have been described in the course of this session.

Professor Poterba: In general, epidemiology or health and economic advice will point in the same direction, but one of the things economics is often better at doing is getting a full menu of choices and opportunities to consider. For example, in the United States, as we were trying to allocate ventilators, there were regional differences in their utilisation. There were situations where there were excess capacities and, at the same time, shortages in other locations. While the health service focuses very much on what to do with the ventilators in its hospitals, the economists in approaching this problem often said, "Why don't we just pick up the ventilators in the rural communities that are not using them and bring them to the high-density hospitals where they are being overwhelmed by patient demand?" That is a very simple recommendation that just recognises that the marginal value of a ventilator is not the same in every hospital in every place. It can have an enormously powerful impact in saving lives in that situation.

I think this is a situation where the economics are absolutely essential to inform the policy design. In many cases it comes from the fact that the social scientists and economists have a somewhat different perspective

on how to frame these issues. They can spot things that might not be on the radar screen for the folks who have been trained as medical doctors or public health service workers.

Aaron Bell: I would like to ask more, but we have no time.

Q785 **Dawn Butler:** Professor Poterba, you talked about a blunt policy not really being effective because people are affected differently by the virus. Does that mean different groups should be protected differently? Should we look at how we protect different groups differently because they are affected differently by the virus?

Processor Propper, you said that there will be a recession in health and in the economy. Which do you think is worse in the short and long term?

I have a quick question to Professor Kay. You talked about trade-offs. I know that is the economic term. From a layman's point of view, does it always have to be about trade-offs?

Professor Poterba: The quick answer is that your question is exactly right in that, when there are differences that could be at a very high level of age based or at a more disaggregate level of comorbidity based—people who are overweight or have diabetes are known to be at much greater risk of mortality from this disease, as well as older folks—it suggests that trying to tailor the shutdown recommendation with respect to those things could be extremely helpful.

How finely you can tune this is very much an open question. Can you really get to the point of saying that someone within the household who has certain comorbidities cannot do things and others can? How do you then separate those groups in a way that does not allow cross-transmission of the virus? That is very hard. But the principle that you might try to fine-tune is exactly the direction that one would go.

Professor Propper: In response to your question on recessions in health and recessions in the economy, I think they are linked. With some of the groups, the recession that we currently have will affect their health, and they are exactly the groups that participate in the economy. So there is a knock-on effect from a health effect of a recession on an economic effect, both for them individually and for society as a whole. They are interlinked. You can see health a bit like you see productive capital. It is part of human capital and part of the input into the economy. Individuals who would be hurt by being out of work and have mental health problems will then be able to perform less well in their roles as parents, workers and carers because of those problems.

Q786 **Chair:** Professor Kay, is it all about trade-offs? Is it all a zero-sum game?

Professor Kay: It is not a zero-sum game, but I am afraid there always are trade-offs and always have to be trade-offs, and often we really do not want to make those trade-offs. We want to be able to say that life is priceless, et cetera, but we do not in the end really mean it. Carol has

explained that NICE has to make an assessment of whether it is worth the NHS spending a very large amount of money on a drug that will extend someone's life, at best, for a month or two. It is very tough to say no, but those are decisions that NICE, practitioners and, ultimately, politicians, I am afraid, have to make.

Q787 **Graham Stringer:** Professor Propper, to stay with the life versus life issue, we know that poverty kills and this virus kills, and we know that switching off part of the NHS will lead to deaths. Decisions have already been taken, albeit on inadequate information. Are any studies being done, or likely to be done, to show whether the decisions that have been taken to focus on intensive care in hospitals will actually have an overall saving of life or might actually lead to more deaths?

Professor Propper: Yes. I am part of some commissioning groups from the Economic and Social Research Council, and the impact of treating Covid patients on non-Covid patients in the NHS and on delayed care is one of the topics that people will be looking at to be able to answer that question. Clearly, we cannot answer it yet, because we know that some people, for example, have not showed up at hospital, but we have to do counterfactual studies of who would have shown up had it been a normal year, kind of thing. We are still waiting for the data on that. The faster we can get health data into the public domain, the faster we can answer precisely the kind of question you are asking—people are interested in asking that. It is a very relevant question.

Chair: I thank our witnesses. We kept them for a bit longer than we promised, but we are very grateful. Professor Poterba, at the beginning, made a generous tribute to the United Kingdom for his early studies. We are very grateful that they are being put to good use in the United States and around the world, and we are delighted to have the benefit of them today. Thank you for giving evidence, and thank you to all our witnesses.

It has been a fascinating session. I think that we established very clearly the importance of gathering more, richer and more timely data, and I think we developed an understanding of the role of modelling as an aid to understanding what is going on, perhaps more than to making definitive predictions about what we might expect to come out.

We heard about the importance of joint work between disciplines so they can inform each other, rather than operating in silos, and about the danger of averages, whether in the R number or some other statistics and broad-brush measures, and how they should be used very forensically to design policy solutions. We have learned a lot from you in the last hour or so, and we are very grateful for your evidence. Thank you very much for coming.

Examination of witnesses

Witnesses: Professor Loughhead and Philip Duffy.

Q788 **Chair:** I am delighted that for this panel we have two chief scientific advisers from two of our principal economic Departments: Professor John Loughhead, the chief scientific adviser at the Department for Business, Energy and Industrial Strategy, and Mr Philip Duffy, the chief scientific adviser at the Treasury. Thank you very much indeed for joining us today to give evidence.

What have been your main responsibilities during the pandemic in your role as chief scientific advisers in your Departments?

Professor Loughhead: During the current pandemic, the main role that I have had is ensuring that the policy teams within the Department have access to adequate information that has been generated predominantly by SAGE and, secondly, that they have understood both the extent and the implications of the evidence, as well as the uncertainties and limitations of that information.

Philip Duffy: I serve as CSA because I am the official with responsibility for science and R&D spending and allied matters such as innovation. During this crisis, my first responsibility has been to ensure, with regard to critical spending decisions and the flow of funds for often very urgent and sometimes novel pieces of work, such as the ACCORD therapeutic trial and the series of measures that we have taken on vaccine production and manufacturing, that that funding is available immediately and rapidly to the scientific community.

Secondly, within the Treasury we have established broad governance to draw together our best understanding of the economic and market data but also of what is happening with the epidemic. I chair a sub-board of that committee, which looks at the impact on businesses and companies.

The third area that has been an absolute priority for the Treasury is to lay its hands as quickly as possible on as much realtime data as possible to support decision making for the Chancellor throughout this process. My team has done a lot of work with other Government Departments and private sector organisations to ensure that we have a very broad realtime dataset that can support the Chancellor and Prime Minister in the decisions they have had to take over the last few months.

Q789 **Chair:** I am grateful for that. During lots of different emanations, the Committee has long taken a great interest in the network of chief scientific advisers in Government Departments. The official role of the chief scientific adviser is to perform an "independent challenge function" to their Department, ensuring that science evidence and advice is robust and influential.

The job spec also describes the role as including that of a "licensed dissident", providing challenge and leadership at the centre of the Department.

Mr Duffy, you are a very successful and distinguished career official in the Department. How in the Treasury do you manage to combine the role of

a licensed dissident with performing your very important functional job?

Philip Duffy: The Treasury has thought long and hard about the best way to engage with the community of chief scientific advisers. We are an unusual Department; our responsibilities cover every aspect of the economy and therefore, on any given day, our Ministers have to deal with an extraordinarily wide range of decisions—on medical information, agriculture, food supply, business practices and international trade.

How I see my role is, first, in making sure that the capability across Government to provide that advice is strong. I have led work over the past year and during the coronavirus to make sure that the Government Office for Science that supports Sir Patrick Vallance and Chris Whitty is well resourced and that we have an appropriate range of experts to advise the Chancellor on questions such as vaccine production, where there are many uncertainties and difficult economic choices for the Government to make.

Secondly, I have also striven to make sure that we have the flow of up-to-date scientific information available and that the Treasury understands and is able to interrogate that information. That is not because we are trying to second-guess what others are doing but, clearly, in many of the areas that you have talked about in this inquiry, such as the impact of being outside on viral transmission and the impact of children on transmission, and the relationship to school reopening, much of the information is ambiguous and often contested within the scientific community. It has been necessary for us to make sure that we have really understood and listened to what SAGE has been saying and understood the working behind that.

As part of that, we have, first, ensured that the Treasury has understood what the so-called SPI-M group is doing and how it has assembled its work on modelling. Secondly, since 31 March, we have had an observer on SAGE from the economics side of the Treasury, Vanessa MacDougall, my colleague who is the director of economics. So that is how we have tried to do that.

Within the Treasury, we have a pretty lively debate about some of the trade-offs that we have to make. I do not think that we lack perspective on that question. But I am confident that we are accessing the range of information and expertise that we need.

Q790 **Chair:** I am very grateful for that comprehensive answer. Your colleague Vanessa MacDougall attends SAGE—that is useful to know. We have had some discussion around the composition of SAGE in this Committee. Very helpfully, the names and disciplines of members are published. I think it is right to say that, of the 90 or so people who have attended one or more meetings of SAGE, only one is an economist or is there as an economist. Given the importance of these perspectives, which we do not doubt, is that sufficient representation in this important group?

Philip Duffy: I am not sure that is quite the way of thinking about the effectiveness of the group. Right now, the group is not a membership organisation; its membership has varied and goes on varying, and is at the discretion of the chair and deputy chair, Patrick Vallance and Chris Whitty. It started with quite a broad epidemiological work programme. If you look at the minutes of SAGE that are available, you will see that it is focusing increasingly on some quite specific questions in the science. A question that the Treasury has been involved in asking it to look at is on the trade-offs around social distancing—1 metre, 2 metres or a greater distance—and how that varies. We have been asking whether it is different if you are side by side or face to face with an individual. We feel that the inputs you need into that process, which is rightly led by those who have the technical expertise to answer those questions, are there.

I have heard people talk about whether you should create some form of economic SAGE or a social policy SAGE, or some kind of allied group that would look at the broader issues. I am quite nervous about that because, when you look at the fine-grain detail of the decisions Ministers have had to make in recent months about the lockdown and reopening, you can see that all of them are a combination of the best science that we can find and our best analysis of the social, economic and political consequences of those choices. There is no simple technical answer to those issues, so I am sceptical of the notion that a few extra economists would somehow accelerate answers or give us a sense of rigour around some of those choices.

Q791 **Chair:** We have heard in evidence from Chris Whitty and Sir Ian Diamond, the national statistician, that the relevant way in which to think about the outcome of the management of the pandemic is not deaths in hospitals solely, but excess deaths, which is being monitored by the ONS. That includes at least three things, one of which is deaths in hospitals of people who have died from Covid. The second is people who have died of other medical conditions whose treatment may have been impeded by reduced access to hospitals for a period. On the third, we heard in the previous session from Professor Propper and others that there are health consequences from measures that are taken in the economy. So it is established that all three are relevant.

There is a lot of advice available in SAGE on the first; it is less clear about the second; but, on the third, if there are health consequences for measures taken in the economy, who can provide that perspective from a disciplinary point of view within SAGE, if it is agreed by the co-chairs of SAGE that this is important?

Philip Duffy: First, I entirely agree with that view of how you have to consider the harm from the pandemic and its responses—and the Chancellor would also endorse that. Within the Treasury, working predominantly with the Department for Work and Pensions, we are particularly worried and concerned about the impact of unemployment on long-term life chances and health. We know, through evaluation of the Work programme and other evaluations that we have done over many

years of programmes in the Department for Work and Pensions, just how deeply corrosive and damaging to life chances in their broadest sense is prolonged unemployment and disconnection from the labour market.

Although we do not have reliable data beyond the end of March on the labour market—that was the last release from the ONS—it showed some pretty startling statistics about the rate of unemployment and job loss. Informed by that, the Treasury has been pretty focused on employment. That is one reason why the Chancellor has extended the CJRS scheme. That is a key rationale for the very high rate of spending that we are currently embarking on, on corporate interventions to support employment across the economy and in every part of the community.

You could go further; you could ask fresh questions about the degree to which the current state of affairs on unemployment beyond what we have seen historically might impact on future health outcomes, and that would be a good thing to do. I do not have a feeling that it would have made a great deal of difference to decision making, if I may say so, over recent months. As soon as the crisis hit, we could see that a high unemployment rate would be bad not only for demand and for the economy but for our fellow citizens.

That was one reason why we pursued that particular policy. Doing a cost-benefit analysis of that would be a very interesting exercise. Naturally enough, the Chancellor's first request of us is to make sure that that does not happen and that we retain as much employment as possible across the economy. That is one of the key goals that my team has been working on in recent months.

Q792 **Chair:** I understand that, and it is good to hear that there is that degree of sensitivity to these questions, but the dilemma is this. If that perspective is not represented and is not part of discussions in SAGE, going forward—and I understand that some of the early decisions may have been more broad-brush; in fact, the evidence we heard in the previous session indicated that some of the upcoming decisions require that more forensic approach—either that advice is available within SAGE, to be combined with different disciplines, or it is provided externally, perhaps by the Treasury.

But the dilemma is this. If the Government continue to make a virtue of always following the scientific advice—and this Committee has heard evidence that there is no material instance in which they have departed from scientific advice—either all that discussion takes place within SAGE and a nuanced recommendation comes out of it, or it has to be possible for the Government, for good reasons, to take the narrower set of scientific advice and supplement it with these broader questions. But if they say that they are always going to follow it, or if they have made a virtue of always following it, you can see the difficulty there. How can we resolve that?

Philip Duffy: First, I would say that the Treasury has a significant influence on the set of questions that have gone to SAGE and will go on going to SAGE. I do not feel we are somehow excluded from asking the questions or putting particular problems into that process.

Secondly, I would give more credit to Chris Whitty and the health experts in understanding some of the points that Professor Kay made in your previous session about deaths of despair and the different ways in which morbidity operates. That is not news to public health experts; it is well established. I do not feel that we have a lacuna in our approach to the analysis.

But—and you make a very good point—particularly as we think about the lift of lockdown and the Government's economic priorities for the recovery, minimising unemployment and some of those other morbidities, thinking hard about how one evaluates the value for money of interventions intended to prevent that outcome probably requires at least some reference to the public health literature. That is something that we will take forward. We talk about that a lot with our colleagues in the Department of Health and the Department for Work and Pensions, and I am confident that we can get that analysis.

Q793 **Carol Monaghan:** Mr Duffy, will you explain a little about the reasoning behind the £1.25 billion committed to firms in the R&D sector? What is your assessment of its likely impact?

Philip Duffy: Throughout this crisis, we have drawn information from every sector and part of the UK economy to understand where we are seeing distress. Our early measures were very much focused on the furlough scheme, ensuring that capital markets were operating and that smaller businesses were accessing finance. A few weeks into the crisis, our monitoring showed that we were starting to see really serious problems for early-stage, high-innovation venture capital firms, with difficulties in placements, and some of the key institutional lenders, frankly, cash hoarding, because of their need to maintain liquidity.

In the Treasury for a long time, going back to the patient capital review in 2017, we have seen a key opportunity for the UK as being our strengths in research, development and innovation, and a key weakness as being the difficulty that our early-stage, high-innovation firms have in raising sufficient funds to get them to scale. We can talk about why that is, and we have done a lot of work on that issue. This crisis suddenly made that worse, and we saw examples of good-quality, innovation-driven firms—the sorts of firms, up and down the land, that we would say will help our recovery—at risk of failure.

So what do we do about that? It is a mix of grant and convertible loan. So it is bringing forward cash-flow grants and expanding what Innovate UK has been doing on the grant and soft loan side, and it is through this thing called the future fund, which has had a very high rate of demand, offering tailored co-investment from the state that could be converted to

equity, so the Government could maintain an interest in what is quite a risky asset class, to make sure that some of the economy's great strengths—the digital economy and high innovation—are preserved for the recovery.

I suspect this will be quite a difficult project and programme for us in future. We know that high-innovation firms fail often—that is not surprising, as they are a risky asset class—but we felt it was the right thing to do at this stage of the crisis, combined with overall uplifts in our research and development spend.

Q794 **Carol Monaghan:** Professor Anton Muscatelli, the principal of Glasgow University and current chair of the Russell Group, has talked about universities and higher education being the missing piece of this puzzle. He warned that higher education, which is worth a huge amount in terms of its economic impact, has been put at risk by a piecemeal package of support. What consideration has been given to the role that higher education plays, and the collaborations between public and private entities, so that—as we think could happen, if we enter a long recession—they are able to sustain themselves over that period?

Philip Duffy: I and my colleagues would certainly agree with Professor Muscatelli that the university sector is, in its own right, one of the jewels of the UK economy and offers enormous potential to boost growth, not only in the classic locations but across the whole of the UK.

The situation in universities right now is that we have seen slowdowns in research. Many research groups have faced a drop-off, and we have been working with universities to make sure they can access appropriately the CJRS and other furlough money. They potentially face a very difficult set of situations—those that are research intensive and reliant on overseas student fees for income. We know that in many institutions that income is cross-subsidising what the UK Government offer in research and development grants.

You have put your finger on a very live debate. What we do not know as I talk to you today is how long it will go on for and how severe it will be, and what the most appropriate range of support might be for universities. We have done a few small things; we have brought some money forward, released in England some fee income faster than we normally would have done, and bolstered how research grants are paid. But we are conscious that this is still on our to-do list, and we do not rule out looking again at this problem later in the year—for example, if we see significant numbers of foreign students unable to travel to start their academic course next year.

Q795 **Carol Monaghan:** May I interrupt you there? You said you have brought forward some of this money, but we know from what Universities UK is saying that this is just a reprofiling of money; it is not really new money and it is not going to solve things long term. Of course, we have had no commitment yet that that money is going to have Barnett consequentials

for universities in Scotland, although we have asked that question. May I ask again what financial support is being put in place for universities that will actually have a long-term impact?

Philip Duffy: To deal with your Barnett consequential point, because I know it is an issue that will be of concern to your constituents, the important point is that throughout this entire crisis we have applied the Barnett formula where it is appropriate, and not where it is UK spending. As you know, the money for universities is a mix of devolved and UK interventions, so some will be Barnetted and some will not, depending on the mix of funding that we put to you.

I think the implication is that we are sort of deaf to reason on universities. We are not; we are listening very closely to what they have to say and thinking very hard about what the most appropriate set of options would be for them. I do not think that you will find an official in the Treasury who does not appreciate their importance to the economy both in Scotland and in the rest of the UK. I am hopeful that we will work collaboratively in the UK to come up with solutions that work for those institutions later on this year.

Q796 **Carol Monaghan:** So, no new money for universities is the bottom line?

Philip Duffy: I think I have been entirely clear that, actually, we currently have this situation under review—so no new money at this stage would be the right answer.

Q797 **Aaron Bell:** May I ask Professor Loughhead about the university research sustainability taskforce set up in conjunction with the Department for Education? Have you had any input into that group's work?

Professor Loughhead: Not directly. To make a distinction, one of BEIS's responsibilities is to drive the policy for science support in the UK, and it also delivers a whole set of other activities—what I call science for policy. I do not have any direct feed into the former; the latter is where the focus of my attention is.

Q798 **Aaron Bell:** On moving forward on research collaborations between the private and public sectors, particularly universities and research institutions, what consideration is BEIS giving to that resilience in a potential recession? Obviously, that is a question for Mr Duffy as well. How are we making sure that we are resilient with our research? This Committee has already had an inquiry into the Budget, and we welcomed everything that came from the Budget, but the concern is obviously that we go backwards. From the BEIS perspective, what are your thoughts on that?

Professor Loughhead: I suggest Phil answers that question because, as I have just explained, that is not the area where the BEIS CSA has direct input.

Philip Duffy: We would say that maintaining broad capital formation, including research and development, is probably one of the most critical elements of delivering an effective recovery. As you say, the public sector contribution towards science is set to increase steeply over the coming years. It was £10.6 billion in 2018-19 and £11.4 billion in 2019-20; following the Budget, it will be £13.2 billion in 2020-21, which will rise to a total of £22 billion by 2024-25. So we are doing our bit there, but, as you say, there is more we can do to link up with the private sector in this area.

First, in the Budget, we increased the generosity of our research and development expenditure credit, the RDEC, from 12% to 13%. Compared with comparator jurisdictions, that is a very generous tax relief, because it is paid even when companies are making losses and have no tax bill against which to offset it—it is an above-the-line tax credit. That is a really important piece of spending, which cost us £4 billion last year, in that approach.

Beyond that, there are a couple of areas where we are very keen to improve our performance. The first is the whole question of inward investment. We know that a lot of global R&D is highly concentrated in a small number of firms. The UK has traditionally not been successful in anchoring many of those firms, particularly in pharmaceuticals, in the UK, and attracting those companies in. We are working on a new strategy for that, which has cross-Government approval, and we are using the Covid crisis to spearhead some of that work.

You will be aware that one of the themes the Prime Minister has asked the Government to pay attention to is in bringing more long-term vaccine and medical manufacturing into the UK, so we have the capability to respond to future pandemics—but also to anchor some of those research and manufacturing bodies in the UK, together with their high research intensity investment.

The last thing I will say and then I will shut up, but it is an important point, is about making sure that the really important companies in our economy that do so much on research—I will not name them, but I am sure we can all think of some of them—are appropriately protected and the relationship is maintained during this crisis, so that the crisis does not inadvertently lose us significant research and manufacturing capability. My team is working very actively on that now.

Q799 **Aaron Bell:** You mentioned vaccines. What was the reasoning behind the £313 million figure that we have allocated to R&D efforts? Obviously, some of that is domestic and some international. How did the Treasury work with other Departments to determine that amount of funding and its allocation?

Philip Duffy: Even with the scale of potential unemployment and economic loss from this crisis, a vaccine that shortens the duration of the so-called NPIs or returns the economy to growth, even by a day or two,

would have extremely high value for money. Although we have not waived our normal approval processes, we have been absolutely clear, with BEIS and the Department of Health, that we will do whatever is necessary to accelerate credible vaccine production and manufacturing in the UK, and for the wider world.

To date, we have spent to my knowledge £272.4 million on vaccines. That is a mix of R&D—about £158 million of research and development—and the rest is actually direct capital to support manufacturing capability to ensure that, should a credible vaccine be found, it is available to the UK population as rapidly as possible.

That is really only a down payment. When we look at the range of things that we would need to do to bring high-volume vaccine manufacturing and development to the UK and the wider world, we are well aware that more money may be needed. We have a dedicated team reporting to me in the Treasury who are expediting approvals for those things, and the Chancellor and Chief Secretary are absolutely clear that it is one of their top priorities.

Of course, it is not just about the UK; it is also about the wider world. We are very active participants in CEPI and some of the Gavi processes to provide funding globally for manufacturing vaccines. We are very proud of the UK's record on developing credible vaccines, and we are thinking about the role of UK manufacturing and wider world manufacturing in how we scale up and deliver a credible vaccine at the sort of scales at which it needs to be delivered globally.

That is the rationale for those areas. I suspect you will find us spending significantly more funds on vaccines over the course of this year.

Q800 **Aaron Bell:** On the same topic, but from a different angle, does the Treasury essentially have a model in which we get a vaccine and one in which we do not? As you said, it would be incredibly valuable if we had that vaccine, but there are doubts about how long it will take, and the shape of what happens economically and societally will be very different depending on whether it is possible to get one by Christmas, as we have heard from some witnesses, or whether it takes 18 months.

Philip Duffy: The Treasury has no special insight into what will happen with all these vaccine projects. CEPI has looked at a list of almost 60 vaccine products that are being developed, and it identified the 10 leading vaccines, of which I think three are in the UK or use lots of UK material. Of course, we are hopeful that one of those products will be successful, but you are absolutely right that there is no certainty on that.

It is important, given that, that we do not forget about the importance of looking at therapeutics in this process. We already have a very large recovery trial under way, which the Treasury has been supporting, and we are also heavily involved in the ACCORD exercise, looking at how we might sample an extremely wide range of compounds very quickly, using

the patient flow, to find early potential treatments that could reduce the death rate, morbidity and the load on the NHS more generally. We are watching that very carefully. Clearly, if we find treatments out of that programme, and the scientists that I have talked to are optimistic about that, we will also need to ensure that they are available at scale to the UK population. We have thought hard about that.

Q801 **Chair:** Professor Loughhead, in thinking about the recovery, we know that the Business Department is supporting two taskforces to assist the sectors in recovery—pubs, restaurants and non-essential retail. As chief scientific adviser, are you involved in providing that advice, or participating in the provision of that advice?

Professor Loughhead: The majority of advice required for that revolves around health advice. For those two taskforces, that comes directly from Public Health England, and the people involved from PHE on that taskforce are directly linked to the PHE representatives on SAGE. Essentially, it is predominantly about the health aspects of the revitalisation or return to normality of the sectors.

Q802 **Chair:** One of the live questions in recent weeks is on the appropriateness of the social distancing measure, with the WHO recommendation being 1 metre and other European countries practising 1.5 metres. We know that that is very important for the hospitality sector in particular. How does the Department, scientifically and through its expert familiarity with the issues, contribute to that discussion?

Professor Loughhead: The information on that predominantly comes from the environmental and modelling group set up under SAGE, which analyses the evidence. As I am sure you are aware, it is an extremely complicated area. Within the last couple of days, it has updated its advice on that. We have been through the updated advice and have fed it through the SAGE system into how that can be interpreted as these different sector-opening options are being considered.

Q803 **Chair:** Given the discussion we have had with Mr Duffy—and with the previous panel, if you listened to that—there is clearly at this stage of unlocking the need to bring together the medical and epidemiological advice and the impact on employment, which we have established also has an impact on health. That is very important. Who is advising on behalf of those businesses that may be able to operate at, say, 1.5 metres but not at 2 metres? Who is feeding in their analysis?

Professor Loughhead: The advice that is being given on the social distancing includes the fact that the actual behavioural aspects are extremely important. As you know, whether you have face-to-face or side-to-side contact, duration of contact and the condition of the people involved, and other measures such as potential facial coverings, play quite a role. What we have done is to make sure that the knowledge on that is taken into account by the taskforces looking at these sectors. Particularly, we have been working with the HSE, which has also been

feeding into that, to look at the extent to which operating practices are able to be developed that will give perceptible mitigation and risk. It is a multi-agency approach. It comes from PHE, the HSE is involved, and we are involved in analysing the evidence. That all feeds through into the taskforces, which take all those things into consideration in coming up with the recommendations for these areas.

Q804 **Chair:** When do you expect those recommendations to be published?

Professor Loughhead: I am afraid that I cannot give you reliable information on that—that is for the taskforce and the Secretary of State to decide.

Q805 **Chair:** Do you have a feeling on whether it is imminent or weeks away?

Professor Loughhead: The work is quite advanced. I shall leave it at that.

Q806 **Katherine Fletcher:** Thank you so much for your time. I know that you have not exactly had a quiet three months.

What we are trying to do here is almost like keeping a record in time while we are all in the trenches still digging. I want to ask your opinions, starting with Professor Loughhead, on the science and technology and the evolution that has happened in business during the pandemic. Have we seen things advance, and what is going to stick? What will be longer lasting, if you believe that any changes have been made?

Professor Loughhead: Can I just clarify that you are asking how the experience of the pandemic may have changed practices or procedures in businesses?

Katherine Fletcher: Yes, and the way in which we have used technology and science. The average man in the street would not have been able to talk about an R value four months ago, but they can pretty well now. There is an example.

Professor Loughhead: I will separate out the epidemiological side of it, because that has been the subject of intense media discussion. One thing that I have been involved in is looking at exactly the aspects you have described—the extent to which a system such as the one we are using now has become more acceptable and widely used, and the consequences for how businesses may operate their systems going forward. If we do that, it opens up a lot of questions about the resilience of the infrastructure systems on which they depend, which opens up the degree of attention that we will give to the resilience of those systems if they are going to become more important.

We have seen the impact on the retail sector, with the closure of shops and a shift to online practices of purchasing, which opens up a number of possibilities for the technology that might underpin online shopping and could lead to an acceleration of the kinds of areas that we would need to support in future, if we are to consolidate that and take advantage of it.

Q807 **Katherine Fletcher:** Could you give us a for instance?

Professor Loughhead: As one example, it is possible that, if you are shopping for clothes, we now have the technology fairly easily to make digital twins of individuals' bodies. We have emergent stages whereby, through simulation, we can show what the appearance of a particular item of clothing would be on that digital twin body. So you can demonstrate what it would look like on a specific person's body with a specific example of an item of clothing. That is not at the stage where it can be rolled out. But we are looking at things of that form, to ask whether these are the emergent areas that might not have happened previously, which may become of accelerated interest as we move out and into a modified economy.

Q808 **Katherine Fletcher:** Very interesting. Mr Duffy, would you add anything on what is going to stick off the back of this crisis?

Philip Duffy: It is something we are thinking quite hard about for the recovery, to make sure that our priorities and spending priorities meet the needs. I think we are all very interested in the degree to which technology could improve the delivery of regular health services. We are absolutely alive to the risk that people who are seriously unwell are not going enough to the doctor and seeking treatment early enough. The chief medical officer has been absolutely clear that people should use the NHS—it has capacity and is open. But we are also interested in seeing more routine measures, such as the use of online consultations and new technology to deliver better health services for more people. That is one thing that it will be interesting to see.

Already in the March Budget, which feels like a very long time ago, we stressed the importance of broadband and 5G, not only in London and the south-east but in every community across the UK. That is going to be of increasing prominence. People feel that high-speed broadband for this sort of call is now an absolute essential. I think there will be shifts to make sure that for those critical supply chains, including vaccines and medical products, we have access during a crisis, which may lead to some changes in our economy.

Another one is transport. Prior to the crisis, we were seeing that the everyday commute had perhaps got a little less common, particularly in big cities, whereas travel to see friends and relatives and business travel continued to go up. I suspect that will be the trend going forward after the crisis.

One last one, which is very important for economic policy makers, is the degree of competition in the digital economy. The Treasury had Professor Furman from the US do a review for us on digital competition. One of the consequences of this crisis could be a further market consolidation around a relatively small number of dominant technology and retail firms. That would be a concern for us, because it could inhibit growth and

innovation in the economy during the recovery. We will have to return to that in our economic policy making.

Katherine Fletcher: Thank you very much. Let us look forward to bouncing out.

Q809 **Mark Logan:** Mr Duffy has great foresight, because he started to answer the question I have for Professor Loughhead. What technologies do you think provide the greatest promise to support the UK's economic recovery? Do you agree with what Mr Duffy has said? Do you have additional advice on our economic recovery?

Professor Loughhead: The points Phil made, particularly around the importance of infrastructure to deliver these new services, and the reliability of that infrastructure, are absolutely key. Identifying specific technologies that we can exploit going forward is more difficult; it would be a bit of a personal projection on my part. What we are trying to do is to identify the evolution in the operation of businesses and to pick up what technologies might come more to the fore. We have just given some examples in the last answer, so I shall not repeat those.

Q810 **Graham Stringer:** I have two questions. It seems to me, Professor Loughhead, that everybody's pet project is absolutely ideal to be a source of growth when we come out of the recession that is bound to follow this Covid crisis. Have you commissioned any research to see what is likely to be the best technology, particularly bearing in mind the potential for sustainable parts of the economy?

Professor Loughhead: It is always difficult to say what is the best technology, but the concept, post pandemic, of seeking further to develop those elements of a sustainable economy is very much at the forefront of our thoughts.

Can we commission research to do it? It is more difficult to make that prediction. We have some key drivers. The UK still has its net zero target by 2050, which will require an extensive modification of large parts of our infrastructure and practices. We are still actively working on looking at how we can deliver different parts of that, to continue to decarbonise the electricity system, looking at new forms of industrial structures and processes that will support it, and the whole question of heating and cooling in houses. With our colleagues in the Transport Department, we are looking at the options for future transport. That is one sector where it will come through. We have touched on the others in terms of communications and new forms of retail. All those things are being worked on, in spite of the load caused by the response to the pandemic.

Q811 **Graham Stringer:** But you have not commissioned any research to see which might be the most productive area?

Professor Loughhead: Frankly, I think that is quite difficult. If we could find a way of doing research to say what would come forward, that would be invaluable, but, very often, this is like moving forward in unknown

territory, as we develop and exploit technologies of interest and build that information about them.

Q812 **Graham Stringer:** You mentioned the net zero target for 2050. I do not know whether you listened to our previous session, or any previous sessions, but we have become interested in models—economic models and models that try to predict how the epidemic will go. You have a costing model for the net zero objective that is secret. Will you publish it, so the Committee can look at it? I know you have turned down freedom of information requests to make that costing model public.

Professor Loughhead: I shall have to defer that question to my Secretary of State and the Permanent Secretary, because the decision on whether it is published does not rest with me.

Q813 **Graham Stringer:** Can you think of any reason why it should not be published?

Professor Loughhead: One reason why there may be reluctance to publish at the moment is that it is still work in progress. As you know, when work is under way, sometimes the information is at a partial stage and not fully checked.

Q814 **Graham Stringer:** Will you check with the Secretary of State for us and write back to the Committee?

Professor Loughhead: I would be very happy to pass on the request that the information is published.

Q815 **Zarah Sultana:** I want to go back to the point about universities, which will be receiving £2.6 billion of fee income early, ahead of the academic year in September. As Carol said, this is not new money; it is a loan, and there is a fear that it is delaying the inevitable bankruptcy facing universities, which will have to implement social distancing and have far fewer international students. Also, potentially, domestic students might defer their studies. We know that, before coronavirus hit, many smaller universities were struggling, facing large deficits year after year, and even more prestigious institutions were taking on increasing debts. Universities UK has asked the Government for a £2 billion bailout to help with the effects of the pandemic. I know Mr Duffy said this is a live issue that has been worked on. I have two universities in my constituency, Warwick and Coventry. Given the urgency, will Mr Duffy tell us whether there will be a support package on this relatively soon, because it is a crisis in waiting? If so, when can we expect to hear more?

Philip Duffy: I do not have a timetable for an outcome for you. It is worth saying that we are looking very carefully at the structure of university financing. We are looking under the bonnet at the levels of reserves and the cost base. We are not doing that to target universities; we are doing it with all the people coming to us and asking for assistance, because we need to make sure that we get the very best value for the taxpayer in that process.

That is ongoing work. I reassure you that we do not underestimate the challenge. I would not want to give you the impression that we were blasé about the degree of distress in the sector. We are not; we are well aware of the level of very real challenge that many institutions face.

Q816 **Chair:** As you may have gathered from our questions in the previous session, we are very interested in the breadth of advice on releasing measures from lockdown, and the sense that they need to be forensic decisions, informed by the evidence. In that context, one of the current policy decisions announced earlier this week is the quarantining of passengers for 14 days. Mr Duffy, did you provide advice in the taking of that decision?

Philip Duffy: We were aware of it, and we fed in our initial view, which was that, in an environment where we got disease transmission to a low level and were releasing parts of the domestic economy, we can see a strong rationale for border measures—for air bridges, and so on.

It is worth saying that those taking the decision in the Home Office and the centre of Government had to work up that proposition without clarity on the forward path of death rates or disease transmission. Even as we speak today, the degree of transmission is contested. We have had the ONS report this morning showing quite a low level of transmission, which contrasts with the numbers that we have seen from Cambridge and elsewhere, which imply a much higher level of transmission. We are having to take these decisions in a quite ambiguous situation.

The Treasury, for its part, is concerned about the forward look on this agenda, to ensure that those sectors that are most exposed—the airlines, airports and the travel and tourism industry—have greater clarity on what will be happening in future months. I understand that the quarantine measures that commence on Monday will run initially for three weeks, and, as the Transport Secretary made clear this morning, the Home Office and Department for Transport are actively working on whether there could be some form of air bridge with other jurisdictions, whereby we are happy to see people travel more freely between those areas. That is our position on the quarantine measures.

Q817 **Chair:** Your role as the chief scientific adviser in the Treasury requires, going from the job description, providing challenge and leadership. We talked earlier about being a licensed dissident. Have you weighed in to this debate and questioned and challenged, to use the word in the job description, the scientific advice? Are you satisfied that the scientific advice is consistent with the policy that has been adopted?

Philip Duffy: I do challenge, but I tend to find that really robust and honest challenge is best done privately rather than in public, and that is what I shall carry on doing.

Q818 **Chair:** Are you satisfied that three weeks is the right period? Should it not be shorter, if the statistics show we are making good progress before

we get to the three-week point? Is there a facility to bring that forward?

Philip Duffy: The number of passengers actually travelling at the current time, quarantine or no quarantine, is vanishingly low. I think that one day last week at Gatwick airport there were 21 passengers, and many of those were domestic, for essential reasons. Secondly, the Foreign Office is advising against all but essential travel for UK nationals. Until that policy changes, this is a somewhat academic discussion.

Q819 **Chair:** But it is a chicken and egg situation, is it not? If the advice is not to travel and there is a quarantine restriction, it is unlikely that there will be much demand for travel, whereas if people had confidence that they were going to be allowed back without quarantining for 14 days, there might be more response to that. So you can see that there is an interconnection here, I am sure.

Philip Duffy: Yes, I do see that, but I just point out that prior to the quarantine announcement people were not travelling, and Foreign Office advice was against them travelling.

The third thing I would say, and the Treasury was consulted on this, is that there are significant carve-outs for the quarantine measures, for people like scientists who are travelling—for example, many of our vaccine staff coming from overseas to help with manufacturing vaccines—and for critical air crew and those working on customs, where we think it is very important. So the Treasury was listened to on that by the Home Office and Department for Transport, and we are quite happy about where we got to.

An important point about the lockdown is that business tells us time and again that it wants a bit of notice to remobilise. Airports are complicated things; a lot of terminals have been closed, and they have shut down runways in the case of Heathrow. So we need to have a realistic timetable before we make any changes. I hope that this review point will enable the Home Office and DfT to look at the evidence and come up with a forward path that makes sense.

Q820 **Chair:** You are communicating to the Committee that you discharge your role of being challenging and bringing evidence to bear from your particular perspective—the economic perspective and others—and that you deploy that frequently and robustly, although you do it in private.

Philip Duffy: People tell me that I am quite robust, yes.

Q821 **Chair:** I have a final point from one of my colleagues.

The data on the rate of infection comes out very frequently. We have the ONS data and the data from hospitals. You have seen some of the discussions about the quantity and reliability of data. Are you engaged in efforts to improve the amount of data to which we have access? Do you have confidence that the data we have is reliable enough to indicate that the rate of infection is falling, as we believe it to be?

Philip Duffy: The gold standard in the ONS sampling regime, which is reporting on fortnightly blocks, has been a major step forward. We feel that a much more fine-grained set of data is needed about who has tested positive and what mix of general community transmission and so-called nosocomial transmission from care homes and clinical settings is going on in the wider community. That is very important.

The Joint Biosecurity Centre is probably the way forward for delivering that, because it should give you a much more fine-grained reading of where the transmission is happening. We have seen today coverage of a potentially large number of cases in north-west England, which is clearly of great concern.

Key to all that, of course, will be the frequency and availability of testing. We are talking to the Department of Health and Social Care a lot about whether there are reliable new technologies that do not give false negatives, which you could deploy faster and in more settings, to give people much more confidence about the level of the disease.

During this crisis, we have had to drag into the Treasury an awful lot of realtime economic data to help to inform decision making, and understand compliance with the measures—traffic data, electricity usage, publicly available data on search and internet use—to try to understand how the public are reacting and responding to that, to help to reinforce the work of SAGE and SPI-B on behaviour and to make sure that we are not accelerating the lockdown faster than it ought to go.

That has been a really positive intervention. There are limits to it, because this data is not validated, and its valency has not been proven over time, in the way ONS and other economic data has been. But I think there is an ambition from senior Ministers in this Government to make sure that the civil service is much more focused on realtime data, to give them better-quality advice on the choices they are making. That may be one of the silver linings, if I may say so, of what has been economically a pretty catastrophic few months.

Chair: I thank both witnesses for appearing today. As Katherine Fletcher said, we know that you are working extremely hard. It is important for us to understand the way in which the policy is being put together, for the purposes of being able to look back and to be able to make recommendations along the way.

The work that you are doing is extremely important. Given the current composition of SAGE, your role as chief scientific advisers in the Department for Business and the Treasury is of great importance in making sure that we have the evidence and analysis to combine with the important medical and epidemiological advice. We are very grateful for your work and for your appearing before us this afternoon.