Ep. 22 Productivity Puzzles podcast transcript

Science and Innovation Policy for Hard Times
Episode release date: 16 February 2023

Host:

- **Bart van Ark**, Managing Director of The Productivity Institute and Professor of Productivity Studies at The University of Manchester (BvA)

Guests:

- **Richard Jones,** Vice-President for Innovation and Regional Economic Development and Professor of Materials Physics and Innovation Policy, University of Manchester (RJ)
- **Diane Coyle,** Bennett Professor of Public Policy, University of Cambridge (DC)

BvA: A new government department for Science Innovation and Technology. Will the new standalone entity turn Britain into the science superpower it would like to be? And will it lift productivity growth, which is so much needed? We are going to find out. Welcome to Productivity Puzzles.

Hello and welcome to Productivity Puzzles, your podcast series on productivity, brought to you by the Productivity Institute. I'm Bart van Ark and I'm a Professor of Productivity Studies at The University of Manchester and a Director of the Productivity Institute, a UK wide research body on all things productivity in the UK and beyond.

Welcome to the second episode of Productivity Puzzles Season Two. Today's discussion is very timely, last week we witnessed a major reshuffle of government departments, in the area of economy business, innovation and energy, which, among other things, led to the creation of a new government department for science, technology and innovation. So there's no better time than to step back a bit and think about the challenges and opportunities for science and innovation policy and, of course, what can be done to strengthen the role of science and innovation raising productivity.

So, to do that, we benefit from one of our researchers at the Productivity Institute, Richard Jones, who is a Professor of Material Physics and Innovation Policy, but also Vice President for Regional Innovation and Civic Engagement at The University of Manchester. Richard just published a paper titled Science and Innovation Policy for Hard Times, an overview of the UKs research and development landscape. You can download that paper from the TPR website at productivity.ec.uk, but we will also, of course, show you a link in the show notes.

Now, the paper is based on nine posts that Richard put out on his own website, softmachines.org and it's a great and very readable overview on how science and innovation policy in the UK has come about, in the past decades, what has changed and what will have to be changed to deal with the challenges ahead. And the report is packed with lots of interesting examples and cases, illustrating his main point, which is that the science landscape, in the UK, has dramatically changed and is perhaps more challenging in what are called 'the hard times', that are in the title of his paper.

So, Richard, welcome to the podcast, I'm really looking forward to this conversation, let me ask you a very simple question, why is your site actually called softmachines.org?

RJ: Well, that's not, in fact, so simple. It's called Soft Machines, because in about around 2004, I wrote a book called Soft Machines and it was a book about nanotechnology, it was called Nanotechnology in Life. And, so, people will recognise Soft Machines, of course, was a famous book, written by William Burroughs, which, you know, had the conceit that human beings are soft machines.

And, at a time, when people were talking about nanotechnology very much, in terms of Schunk mechanical engineering, cogs and gears whirling around, I really wanted to make the point that the nanotechnology that we know that works, which is biological nanotechnology, all the machines in our bodies and cells, actually operates on very different principles. And I called those principles, you know, the principles of soft machines, actually, because the branch of physics I come from is called…well it was called matière molle, by the great French Nobel laureate Pierre Gilles de Gennes, which, of course, means soft matter and it's that idea of matter being mutable, flexible, constantly changing shape, in response to Brownian motion.

That was the thesis of my book that was…that if you wanted to make a synthetic nanotechnology that did some of the things that biology did, you would have to understand there is different principles of soft machines, of mutability and motion and all that kind of thing.

So it was that, yes, so my blog has been going a long time and it perhaps has more about science policy now, than it did in those days, when it was much more about physics and nontechnology. But, there we are, it's still soft machines.

BvA: Ah, so, great, so, here we had the first science lecture of this podcast. I would recommend to go to the site, because, in addition to nanotechnology, as you say, there's a lot on innovation and science policy there, which is perhaps for the broader audience quite interesting to look at softmachines.org.

Now, of course, I don't want to do this podcast, just on my own, asking the difficult questions, so I called again on someone who has, by now, become, sort of, my sidekick for Productivity Puzzles, Diane Coyle. Diane is Professor of Public Policy at Bennett Policy Institute at University of Cambridge and she is our theme lead in the Productivity Institute on Knowledge Capital. So who else to invite to ask the really difficult questions to Richard, so, Diane, welcome, and thank you for joining us today.

DC: It's a pleasure to be your sidekick, Bart.

BvA: Looking forward to it, I hope we do more of that, maybe one day I can become your sidekick, who knows? Okay, so let's go straight into this. I want to talk maybe first, not so much about science and innovation policy itself, we'll go there, but maybe first talk about the hard times, which are your title, Science and Innovation Policy for Hard Times.

So, from the perspective of science innovation, Richard, what are, sort of, the hard times that we are currently facing, that really need to be understood, if we want to get to a better place with science and innovation policies?

RJ: Well, I think it's, you know, it's obvious, I think, that we are in…there does seem a bit of a feel of national crisis, at the moment, and, of course, we've had some very severe shocks to the system. We had Brexit, we had a pandemic, we've got a war in Ukraine, which has caused all kinds of breakdown of supply chains. So there have been a lot of shocks, but, of course, in this podcast, I hardly need to say that, underlying all that, is this very long term slowdown in productivity growth.

So we've seen productivity growth slowing down ever since the global financial crisis in the UK, there's a particular regional aspect too that we have most of the UK is, in fact, below average in its productivity performance. We've got big cities, in the UK, like, Birmingham and Manchester and Glasgow, which are actually below the UK average. So contrary to the norm that we expect from agglomeration economics that we have big cities driving productivity in the UK, the reverse is the case.

So, given the fact that it's a common place to say that the productivity growth arrives from innovation, not entirely, but frequently technological innovation, this suggests that somethings not quite working in the way that innovation system is operating. And, in fact, you know, we haven't got time to go into the details of where the productivity slowdown comes from, you've covered that very well in other podcasts, but, you know, the point that I would want to bring out is precisely the point that Diane's work has shown, which is that a lot of the slowdown actually comes from those sectors that, in the past, we've thought of as having been drivers of productivity growth.

So areas like pharmaceuticals, the productivity slowdown offers the backdrop to this and then we have additional challenges, we've got the transition to net zero, I still believe is under appreciated, in policy circles, what a wrenching economic transition that's going to be, you know. We've had, to some extent, we've made good progress, in the UK, in decarbonisation, but largely by doing the easy things first, as, of course, one should do.

But there's a huge way to go in decarbonising the transport system, decarbonisation domestic heating, which is a huge consumer of fossil fuels, decarbonising energy supplies for industry, we've got that wrenching transition, I think that's going to depend on innovation to make that achievable.

Security, you know, we've had…since the end of the Cold War, we've had a peace dividend, it's arguable that we, kind of, consumed our peace dividend, we cashed it in and used it for consumption, rather than other forms of investment, but, you know, that peace dividend is in question again. Clearly the world seems a much more dangerous place.

So some resources will need to be reapplied to those questions of security and, you know, at a time when, you know, we've got very acute crisis in the health system, but that acute crisis, again, I think, is the playing out of long term issues and, in particular, we've had a slowdown in life expectancy, even before the pandemic, the increases in life expectancy were slowing down and we have huge disparities in health outcomes across the country.

So, you know, in Oldham, for example, a healthy life expectancy is almost ten years less than they are in Oxfordshire and, of course, that contributes, that feeds directly in to the productivity problems that we have.

So you get this sense of a whole bunch of issues coming together and this slowdown in productivity perhaps underlying all of them, if we think that productivity growth is driven by innovation and we think technological innovation is a big part of that, then that's telling us that somethings not working in the connection between science, technology, innovation and productivity growth.

DC: I wonder if I can follow up on that, Richard. The term 'hard times' took me to the Dickens novel about the miseries of the industrial revolution and the way that all of those innovations did nothing to benefit people for a very long time. And a couple of years ago, there was a really well known paper in economics by Nick Bloom, and other co-authors, called Are Ideas Getting Harder to Find? And they said, yes, they were, in the sense that there are a lot of researchers, a lot of money being put into research, but the number of new ideas that were coming out of that, in lots of areas, seemed to be declining.

And, yet, if you look at innovations, you know, AI, in recent months, energy, that you've been talking about, biomedicine materials, there seems to be lots of ideas and I wonder where you come on that debate? Is it that the ideas are actually getting harder to find? That the research itself is getting less productive or is it something in what Will Baumol used to call The Free Market Innovation Machine? There's something in between the ideas that the scientists produce and how those get turned into benefits in society. Is that where the problem is?

RJ: Yes, I mean, my position on this is intermediate, I think. There is a slowdown in innovation, you, of course, can talk at great length about GDP and whether we're measuring that right, but, nonetheless, I think there is a sense that those improvements in living standards, that we've come to expect, aren't being delivered. But, yes, as you say, you know, in my other life, I still try and be a scientist and I'm working on some very, very cool new

technologies, you know, I'm working with Cambridge collaborators on a great technology that could make solar cells 30 per cent more efficient. So, yes, absolutely, they are fantastic discoveries still happening.

So I think my position would be there has to be something wrong in that connection, in that innovation machine, you know, in the sense, we're not perhaps trying harder, we're not putting the efforts in the right places that convert ideas into our productivity growth.

BvA: Yeah. So lots of challenges, there was one challenge which, you know, some people say we couldn't talk about for a long time, but, now, apparently, we can again, which is Brexit and, of course, in the paper, you do talk very extensively about the whole issue of Horizon Europe and the European Research Council, how much we have benefited from all that. But, I think my question about that is a little bit broader than that and that is, whether not being part of the EU, or any, sort of, large entity, economic entity, whether that is not actually, you know, a downside for science and innovation, because science and innovation requires skill, it requires deep collaboration, especially for diffusion and on the commercial front.

So to what extent would you see that Brexit, apart from the programmes that we cannot participate in any more, is actually a bigger issue for getting a good science and innovation policy on the road?

RJ: No, I think it is a big issue and, you know, as you say, it's easy to focus on the programmes and think of the programmes, in terms of money, but, of course, the programmes are important, not in terms of money, because you can always think of other ways of financing things, but it is exactly in that sense of having a continent wide competition. And there's a section in my paper called 'Why Do Scientists Love The ERC? The scientists love the ERC, not particularly because it's, kind of, you know, any more generous than any other funding scheme, but it's that sense that if you have a continent wide competition, it drives up people's aspirations, it drives up standards, you know, it's a curious thing that science has, it's a combination of competition and collaboration, isn't it?

You know, you pinch ideas off other people and then you try and execute them better, that's how it all works. So, clearly, the United States works very well as a single scientific market, as it were, because they're a continent scale group of people that are doing that balancing competition and collaboration, I think, various EU programmes were doing very well at making a, kind of, single scientific market and so, yes, not being part of that is, I think, very damaging and unfortunate.

BvA: Yeah. And I would say, on the science side, that's true, but it's certainly it's not true on more the development and commercialisation side of innovations as well, where I think that is an issue.

RJ: And I would add, again, that 'hard times', things are changing, you know, this sense of the world dividing up into three trading blocks and the sense

of CHIPS Act, the Inflation Reduction Act coming in with really major industrial strategy interventions, from the United States side, you know, in the sense China has been operating in that way all the time, suddenly, it feels like a, kind of, cold environment to be a small nation.

DC: Our colleague, Andy Westwood, actually wrote a good blog post about exactly this point that, with the major blocks introducing industrial policies, we are getting left behind in that endeavour. But I was going to add also that part of the post Brexit problem is broader than the EU, it's the, sort of, hostile environment for foreigners to come to the UK and lots of people in universities have had trouble getting visas for people to come and work here. I mean, Bart, I'm sure you've had a really warm welcome from the Mancunians, because that's the kind of city it is, but I don't think the hostile environment can be helping at all.

BvA: And that actually is a good transition to our second part, because it actually comes back in…some of what I think are the key premises of what you talk about in your paper, Richard, in terms of what has changed, in terms of science and innovation policy in the last couple of decades, which is, sort of, really the core of the paper. And I think, and correct me if I'm wrong, but I think what I read in it is, sort of, three critical premises that you have there.

First of all, that very large parts of science and discovery in the UK have been moved out of government controlled entities and institutions and into universities and that, frankly, a lot of that has been cross subsidised in universities by foreign students, that's the link to the point you just made, Diane. So I think that's one first important thing.

The second, that all of this was also done with the thinking that more commercial side of research and development would be done by private businesses and that doesn't really seem to have happened to the extent that we wanted it to be.

And, thirdly, that the role of government in research and development has become a lot more muddled and unclear than it was a couple of decades ago.

Is that a fair summary of what is at the heart of your paper, Richard?

RJ: Yes, I think it is and I think it's, you know, as I say, you know, this is not an original thesis, particularly, I think, you know, I'm drawing on the work of a number of distinguished historians of science particularly.

And, you know, I think particularly here of Jon Agar, Jon Agar wrote a great book called Science Policy Under Thatcher, which absolutely made clear that as, you know, part of the free market term that Thatcher Government, successive Thatcher Governments introduced, was a sense that governments should not be involved in downstream research, in translational research.

There was a case for them to be involved in basic science, but the thesis was that involvement in applied research crowed out investment from the private sector. So there was a very conscious withdrawal of government support from applied research and this was, you know, this also went alongside…there was the privatisation plan and, of course, lots of applied research in the 60s and 70s had been done in the state controlled industries that then became privatised.

There was, you know, a related turn in the way that people thought about corporations that there was a lot more emphasis on shareholder value and the sense that conglomerates should be broken up and efficiency should be sought.

So I think it was the simultaneous withdrawal by the state from applied research and, at the same time, a…well an expectation, as you say, that the private sector would step up to fill that gap and, in fact, the private sector actually, you know, in some ways went in the opposite direction, that moved to shareholder value, the breaking up of large conglomerates, some of them privatised industries, others, companies like ICI and GEC that had been around a long time, but that then led to a rundown of the more, you know, in the sense the further from market work that was carried out in those kinds of commercial entities.

And then one saw, from the late…well, the mid to late 90s onwards, so, you know, this is getting to the weeds here, but, you know, William Waldegrave was a science minister in the late conservative government, he wrote a white paper called Realising Our Potential and there was a move to…when the new labour governments came in, there was a very longstanding science minister, David Sainsbury, who really executed a similar set of policies. There was a lot of policy continuity that was emphasising a basic science being done in universities and then emphasising spin outs as a route by which that science could be commercialised.

So that's been, you know, we've had a lot of continuity in science policy, as I say, from late Thatcher Government, right through the new labour period and then onto the coalition, that things were not actually very different, there was a lot of continuity in the way that people conceptualised the role of the state in science versus the role of the private sector.

BvA: So, much of the discussion on science, and also your paper, is about research and development and intensity of research and development, what we call, sort of, the share of the expenditure on research and development in total GDP of the economy. Now, for the whole OECD, that number, so expenditure on R and D as a per cent of GDP is about two point four per cent and that has, sort of, become the target of the UK Government and some countries are well above that, like, Germany and the US, which are more like, sort of, three per cent.

And, until recently, it looked like the UK was actually more at the bottom of the pack, more like one point eight per cent. Now, the Office of National

Statistics recently revised those numbers and that actually put us right at the target of two point four per cent, we can talk about why that is. That is largely statistical adjustment, however, that doesn't yet mean, in your point of view, that we're really already in a good place with research and development, there's still some specifics about that percentage of the way that we're spending our R and D, that makes the UK an outlier, compared to other countries.

RJ: Yeah. I mean, I think…I mean, we could have a long discussion about the ONS reclassification and I'm not totally convinced actually, about all of it, for various reasons, I go on and I talk about it in the paper. But I think that, you know, it does capture some…there was some clear under sampling, but, in a sense, the…I would still return to by their fruit shall ye know them, if science base was delivering prosperity, we wouldn't worry about it. It isn't, so we should worry about it, whether the intensity says it's one point seven or two point four.

DC: So, regardless of what the figures say and, you know, I agree with Richard, there probably was some under sampling, you have to ask whether setting a target that would get you to the OECD average several years later, was ambitious anyway, even thinking about it not in terms of outcomes, but sheer numbers and, if you think about being in a knowledge based economy, then ideas always drive economic growth, but the more ideas dependent it is, the more the research and development is going to matter.

But it raises, in my mind, and I'd love to hear what you think about this Richard, what is the right level? You know, we can bench mark ourselves against other countries, but do you have any sense about how much R and D there should be?

RJ: Yeah. In a sense, one should step back and say what kind of economy do you want and, on that basis, you'll have some idea of what the numbers should be. If you look at the top end of countries that have a much higher intensity in R and D, you have Israel, with a very…an economy that's very knowledge intensive, in a sense it's very driven, you know, particularly by, kind of, small spinout companies and that sort of thing. Or you can look at Korea, which has a number of very large companies that attempt to corner entire chunks of the knowledge intensive industries.

So I think it's a question of, you know, what kind of economy do you want and that will tell you how much R and D you need to do to support the industries that you think are going to be the ones that are going to drive the prosperity of the country.

And there's one other comment I would make about intensity targets, I mean, as Diane said, you know, two point four was chosen, because that was the OECD average in the late 2010s, the OECD average is, in fact, higher now, I can't remember what it is, but it's more than two point four. But, actually, there's an interesting question about why do we think intensity is the right number? As Stalin is supposed to have said, quantity has a

quality of its own and there's something…this comes back to the question of scale, the USA has a very successful innovation economy, not just because it spends quite a high percentage of its GDP, but as a fraction of the world's innovation effort, that part of it is very high.

You know, I think you could make a case that relatively small countries probably ought to…would need to have a higher intensity, because, in absolute terms, they're not a major part of the world effort. So, you know, another number, which is quite interesting, is the UK is about two point five of the world's scientific effort, which is, you know, it's, kind of, not nothing, but it's not dominant and, in a sense, it's almost a slightly difficult place to be, you're not a super power, but then science is important and you have aspirations to convert that into economic success.

BvA: But if you go below that aggregate number, it seems to me there are some specifics about the UK that still make it a bit of an outlier, right. So, for example, the government share of R and D, versus the business share of R and D and, particularly, if you put it in a regional context, it's quite striking that in some areas, where we have a big business share of R and D, very little government, and the other way around. The issues is in, sort of, the domains on which we spend R and D on, right, I mean, we used to spend a lot on defence, so picking up a bit now, of course, again, but we moved much towards health and, of course, more recently, to energy and industry.

But also I think there's a, sort of, very high concentration in sectors and firms and only very few firms that are big spenders on research and development. I think in your paper, you said that only two UK firms, GSK and AstraZeneca, that are in the top 100 of the biggest spenders.

So there are some specifics that you may want to dwell on a little bit more that I think make the UK a bit of an outlier and, therefore, very difficult to compare these aggregate numbers on R and D intensities with other countries.

RJ: Yeah, absolutely. And these are questions that I don't really have a settled view on, the question arises, you know, another way in which the UK is an outlier is in the very heavy dependence on R and D tax credits, is the way in which it subsidises R and D in industry. And, you know, on the old numbers, it's a little bit murky, but, roughly speaking, somewhere around a third of all R and D that's done in business, in the UK, is actually paid for by the government and that's either by R and D tax credits or by direct grants and contracts.

And, actually, in the UK the split between R and D tax credits and direct grants, the contract is very much…it's a bit of an international outlier, in terms of being so dependent on R and D tax credits. And this, I think, prompts one to sit back and say, okay, why do we actually do this? Why do we subsidise the private sector to do their R and D? And, of course, the well known economic arguments about why you do that, because firms don't benefit from…you know, the society benefits more than the firms do

from R and D expenditure, because of the nature of the difficulty in capturing value and the nature of spill overs.

But then we don't actually then ask ourselves, is all R and D in companies as effective? Are the spill out overs as important in all areas? Now, it's not obvious, to me, that, you know, R and D that's done in a small company, that might well be, sort of, rediscovering stuff that people already know, is the same as R and D that's done in intel that's, you know, driving the next generation of CHIPS.

DC: In fact, there are different perspectives on it. Will Baumol used to divide innovation into incremental and giant leap innovation and he argued that the incremental innovation was by and large done by large companies, that didn't want to cannibalise their own markets, and the big leaps came from a certain number of small companies, that were, you know, science and technology based, and so on.

But if you think about examples, there's a wonderful history of Wedgewood by Tristram Hunt, which makes it clear that not only was the company really keen on design and marketing, it was actually a science based company, it did a huge amount of experimentation with different kinds of clays and firing methods, and so on. Huge innovator and then scroll forward to the twentieth century and, in his wonderful series, Trouble Shooter, John Harvey Jones visited, it wasn't Wedgewood, but another pottery China company and they had just stopped doing any of that at all. So that whole history of scientific innovation had vanished from the industry.

And, you know, again in the twentieth century, big companies like ICI that used to do an awful lot of science based R and D got broken up, got financialised and a lot of that science base inside businesses, kind of, ebbed away. So I don't know that we've got any systematic answer to which kinds of companies do or should be doing R and D and what it is that drives those, kinds of, changes that we've seen through the course of business history.

RJ: Yeah, no absolutely. And I think, yeah, I love the example of Wedgewood, because I live in the Peak District and, you know, you read Wedgewood's accounts, just got on his horse, you know, just, kind of, riding around the Peak District looking for mineral outcrops and, you know, really doing quite innovative chemistry as well as innovative process and, you know, he was one of the first people to be able to measure the temperature of a furnace. And then, you know, we come more recently and, you know, we've got companies, you know, in the United State, Bell Labs famously produce this giant stream of Nobel Prize in discovery.

So I suppose those are all the counter examples to the thought that innovation doesn't happen in big companies and, indeed, you know, ICI supported me in the early part of my career, as they did many scientists and it was a huge pleasure to go and visit the ICI corporate labs in Wilton or in Runcorn and there were, you know, people doing amazing, cool things.

DC: Including, I think, Mrs Thatcher, if I remember correctly, she also worked as an industrial chemist.

RJ: Yeah, no, absolutely.

BvA: We'll take a quick break, so that you can hear also about what else is happening to Productivity Institute.

[Recording played 28:37-29:58]

BvA: Welcome back to my discussion with Richard Jones and Diane Coyle on Science and Innovation Policy in Hard Times. The one thing I want you to dwell on a little bit is the regional component of this, of course, we know that R and D is highly concentrated in the UK, in London and, sort of, Oxford, Cambridge and South East, 46 per cent, I think of all public and charitable spending on R and D is happening in that part of the world. There are some other hotspots, like, you know, Bristol and Derby and West Midlands.

What's also quite interesting is that there are some places, Cheshire, for example, where almost all the R and D is business R and D, there's very little public R and D, whereas a lot of public R and D, as I just mentioned, is actually in the South.

I think my question to you is, obviously, not the whole place can be equal in the intent, in terms of what spends on R and D, it has to do with industry structure and all those kind of things. Why, nevertheless, is it important to you that we think much harder about the regional distribution of research and development? Is there a direct link to productivity that you would think if we would support R and D more, that would make a real difference for the picture that we see?

RJ: And I think there are two answers I can give this, I mean, the first answer about, you know, I think there's a reason, in principle, why geography matters for R and D, you know, people say, well, you know, if scientific discoveries are made, then they can be applied all across the world and that's, of course, true and, you know, we all benefited, the vaccines were invented in Oxford or in Cambridge, Massachusetts for Moderna, we benefited from those discoveries everywhere.

But then I think a lot of knowledge is tacit, a lot of knowledge exchange happens through people and so, you know, the entire history of studying industrial clusters, you know, going back to Marshal is about places where there are a lot of people that know a lot of stuff about how to develop their technologies. So I think that's why geography matters in principle.

I think, in terms of the balance between public and private, in the paper that I wrote with Tom Forth, in 2020, you know, the argument…and this is actually Tom Forth's original argument, was to say, okay, let's look at where the private sector does its research and where the public sector does its

research and that should tell us something interesting, because if we believe that, you know, public R and D is being done to correct that market failure, then you'd have thought there'd be some mapping between where the public and private sector spend their money.

And so, you know, we'd look at Cambridge and you think Cambridge is a fantastic success story, huge amounts of public R and D, but, actually, the private R and D is even greater, so the, kind of, ratio, you know, there's this rule of thumb, you know, roughly speaking, you've got two pounds of private R and D for every pound of public R and D that you put in. In Cambridge, you know, that ratio is much bigger, the private sector puts in much more.

So there's this very intense private sector R and D economy that's supported by, or driven by, interesting question which way around that is, by public R and D. But the interesting thing about the distribution is, as you say, Cheshire has loads of private R and D and not very much public R and D. The West Midlands the same, East Midlands the same.

So we've got these places and Tom Forth is more of a market liberal than I am, so Tom would say, well, you know, the market is giving you a signal and the state is not responding to that signal by supporting that private sector innovation economy, you know, the necessary public goods that public R and D and, you now, the supply of skills, because, you know, lots of this really does come down to people, as much as output of papers, is not matching that.

So that was the argument, of course, you could then rightly point out, okay, we've got places that have got not very much public R and D, not very much private R and D and maybe that's just the way things are and not everywhere in the country…the economy of the country is not uniform, there are parts of the country that, you know, don't have giant pharmaceutical clusters or aerospace industries and, you know, the nature of the transfer state that we operate means that they're fine anyway.

But, you know, I think…Tom and I's thesis was certainly, yes, you may not want to have a high R and D intensity everywhere and there are different things that different economies do and, you know, think about rural areas, coastal areas, that may probably not appropriate to think of them as having a particularly R and D intensive economy, but if you've got big cities, with concentrations of private sector R and D, and the public sector isn't matching that, that's probably saying that there are, kind of, you know, five pound notes on the floor that you're not capturing.

DC: I'm inclined to think we do want R and D, in some form, everywhere, innovation, in some form, everywhere. In one of the early papers about the diffusion of a new technology was by somebody who taught me, Svi Griliches, was a rural example, is about adopting hybrid seed for corn and, if you think now about rural economies, we want to see a lot of innovation, in terms of less intensive farming methods producing the same kind of yields that they get from current intensive farming methods.

So…and similarly, we talk about R and D in innovation in quite broad brush terms, but, actually, the things that people are inventing are much more granular. So, you know, biotech is a way too big a category to think about and if university in a smaller city than the obvious candidates has people who happen to be good at something, then why shouldn't we expect to see that innovation cluster develop there?

BvA: Yeah. I think it also depends a little bit on the type of R and D, right, I think what you explain also, in the paper, Richard, is that, for example, health R and D makes a lot of sense to bring that particular to regions where you have backwardness in terms of, you know, you brought up the example of life expectancy is highly different between regions. Whereas, in defence R and D, there's perhaps less of a need to have it everywhere in the country. So I think there's probably also some difference between the types of R and D that we're talking about.

RJ: And there's a, kind of, interesting case…a couple of interesting cases I can mention. So, for example, Lincoln, Lincoln has a relatively young university, that I think has done very well in identifying niches of R and D that suit it's local economy. One of them is agri-tech and, you know, the need to improve productivity, agricultural productivity. Another one is, you know, wind energy, to do with the development of the wind industry in Humberside.

So, you know, you can find those areas in the strength and places fund that I was a member of the panel on, you know, one of the successful projects there was about the dairy industry in Cumbria and South West Scotland, and, again, you know, it's people finding new high value products from a relatively mature industry. So we can do that.

I think the other geography issue is about…and this follows on from that, how do you decide what R and D to do? What sets the priority? And the argument that…actually, there's an earlier paper that made this argument more strongly with James Wilsdon, was that, you know, in the health and life sciences sector, you know, it was a little bit odd that all our health related research happens in the parts of the country that are the healthiest. And if research priorities were being set by people who were in communities, that had different health problems, problems in North East, Greater Manchester, lots of problems, you know, multi morbidity is a big problem, that, you know, people with a giant set of simultaneous…you know, people who have got, you know, diabetes and heart disease and a whole bunch of other things all happening at once and that's a, kind of, different set of priorities than if you just want to study, you know, a rare cancer or something that's, you know, academically interesting.

One of the reasons why I think it's a pity that we don't have companies like Bell Labs or ICI doing lots of quite fundamental research is…even though we call it fundamental, it was actually motivated by the problems that those companies had. And I think that people in innovation studies pour scorn on

this idea of the linear model of innovation, but, you know, it still has a big hold, people think scientists go and do marvellous pure research that's totally unmotivated by any, kind of, grubby industry or anything and then, somehow, later this turns into products.

But the reality is, you know, lots of fantastic pieces of historically great science were done by people who were actually quite close to industrial problems.

BvA: So we need to talk a little bit about where we're heading with science and innovation policy, so that's what we're going to do as the last portion of the podcast. Now, Richard, before the break, we already spoke about what has changed, over the last few decades, we, sort of, hinted already a little bit of some of the important principles on science and innovation policy in going forward.

So let's talk a little bit on the strategy for SIT policy and, again, as I said at the beginning of the podcast, the timing is good, because we have a new government department here, so they may be waiting for some really good advice. So let's start and hear from you, first, about some of the things that you think actually are working well with science policy, in the UK, and we should continue or perhaps even build on and then perhaps also go into some of the areas where we think we need some change, in order to really adopt new policies that are getting us ready for dealing with those hard times that we've been talking about before.

RJ: Yeah. We do have a strong university research base, there's no question about that and, you know, that's a good, you know, it's good for producing research, but it attracts talented people to the UK, it trains people, it does quite well. So I think, yes, I always have a tendency to look on the dark side, but, you know, the universities do the stuff that they ought to do, I think the gap is in other areas and I think it is in this translational and applied research, you know, again, to go back in history, there's a really, kind of, well known idea, in British science policy, called the Haldane Principle, something that is believed by many to say that nobody should be able to interfere in what scientists want to do, but, actually, that's, in fact, a very incorrect reading of the history.

And, you know, for most of the twentieth century, governments supported science, most government supported science has been absolutely in pursuit of things that the state thinks are important. So, actually, the Haldane Principle comes from the report on the machinery of government, written by Richard Haldane, Viscount Haldane, in 1918 and, actually, it's quite clear what their priorities were and that's beat the Germans. So the examples were all about how can I preserve fish better? And how can I, kind of, guard against the toxicity of TNT?

DC: I don't really mind governments having broad priorities that they want the research they're funding to look into and, you know, a lot of the successful US innovation was defence oriented as well, which we sometimes forget

and, obviously, I agree with Richard, because I'm in a university, that universities do some fantastic research, we've got a great university research base.

It's not very good at addressing problems, I think, because it's really hard to do interdisciplinary research, not because of funding, the funding is there to do it, but because of the system that rewards people for publishing in narrow professional journals and just makes it really hard to come together in problem solving teams. So I do think that's a weakness.

But the bit that bothers me more really is about the translational and applied research and what direction that goes in and, if you think about it, we've had a food industry that has done lots of product innovation, it's developed all kinds of high fat, high sugar, high salt, processed products that are really bad for our health or to take another example, we've got a tech industry that has produced amazing leaps forward in AI, just in the past few months, to do exactly the things people said they didn't want AI to do, replace human creativity in art and music.

So what is it about the economic system that is not only perhaps limiting the amount of applied research that's done, but means that it's not addressing the problems that we need it to address and possibly even creating new problems?

So, you know, it's back to that innovation machine construct that the machine has gone rogue slightly and I don't know how to fix that.

RJ: It's a question of timescales, isn't it? I mean, it's hard problems, that we want to solve, are quite difficult from mechanisms to address, because the returns are too far in the future and too unpredictable, you know, and venture capital is quite effective at taking ideas, from which the technical risk has already been taken away, and developing them.

So in Cambridge, you know, Bill Janeway has written that fantastic book which absolutely, you know, informed by his experience of venture capital industry in the United States. You know, the history of that was the very hard problem of making integrated circuits was done driven by military applications and, you know, the great thing, that I always like to remind people of, the first ever integrated circuit based computers were guidance computers for minuteman missile. So that huge government effort created a substrate for technology development, if you like, in the form of this microelectronics and then the market was able to come in and pick off easy applications for it.

So the question is, how can we get back to finding big problems that we can then take quite a long term view on, but it has to be long term, but actually rather focussed on delivering something and that's something that our current system, neither in universities, nor in the private sector, seems very good at.

BvA: So there are a couple of, sort of, new institutions around science and innovation policy that are, sort of, being addressed, we have the Catapult Centres already for quite a while, you know, which are, to some extent, meant to really, sort of, push the emerging technologies further down the road. So, you know, is that a good concept that we should continue?

And then the other big one, going back to, kind of, mission oriented policy is, of course, the creation of ARIA, where, you know, we basically give a lot of freedom to an organisation and basically say, do whatever you think is good. So can you comment a little bit on these new institutions and whether you think they will make a difference?

RJ: Yeah. I think Catapults are a good institution, I think, in some ways, it's too narrow to think of them as being things that take innovations from universities and translate them into products, you know, again, this comes back to this linear way of thinking, which I think is not quite right.

I would like to see Catapults being much more focussed on how to develop innovation capacity in a region, solving some of the network failures that I think we've got and those network failures, I think, again, it comes back to the loss of those very big companies. Those very big companies had a very important role as both, you know, internal networks themselves, they had many, many scientists working for them in different areas, you know, they didn't have any problems with interdisciplinarity, because, you know, they weren't at all motivated by publishing in their own journals. So there's that, kind of, network failure is something that I think the Catapults ought to think more coherently about.

I'm very supportive of ARIA, as an experiment, partly because I think just doing experiments is worth doing, it's worth trying a different way of supporting science. The innovation that ARIA, I think, has is this idea of a programme director, you know, somebody with a vision for developing a piece of technology, who is then empowered to make that happen. So it's not so much, you know, you don't give money to a scientist, because they've got a great idea and they're going to do it themselves, you give it to someone who is, like, a team leader who can assemble a team.

In the history of the US agency that ARIA, to some extent, is modelled on, there's this guy, Licklilder, who has a, you know, he invented computer networking, more or less, he had a vision of it and he went around and found the computer scientists who could deliver that, you know. So he was the orchestrator, he created the team. So that's, I think, a powerful, you know, new way of organising science.

I do think that, you know, the question of the customer is important, ARPA always work because, you know, ultimately, it was clear who the customer was, it was clear what the goal was, you know, very, very clear mission about the United States armed forces always having technological superiority. So I think defining those missions is quite difficult and important

and, you know, we do hear about mission driven research is something that's, you know, quite popular, particularly it's been very influential in European research policy thinking and I think it's good, but it has a weakness, the weakness it has is not being specific.

So, you know, one can say, net zero is an omission, well, it sort of is omission, but you actually want to know, you know, what do I want to do? Is it about can I make hydrogen from high temperature nuclear reactors or is there some, kind of, almost engineering deliverable that I think needs to be…underlay the specificity of mission driven research.

DC: I think defining the missions is really tricky actually and because it partly speaks to questions of accountability and who gets to decide what the missions are, what are the important societal challenges to address? As well as at what scale to do you set the missions? And it often reads, like, a bunch of people like us sat around in a seminar room, for half a day, and came up with a list of things they thought were important and I don't think that speaks properly to society's needs for innovation.

I really hope ARIA works and I think that will depend on the, kind of, autonomy that Richard was just alluding to and if it turns out that the treasury is going to demand the same, kind of, accountability in short term value for money, that it usually does, then I fear it won't work well and, as you know, Bart, one of my preoccupations is that we keep changing stuff all the time in this country, policy is so inconsistent and there's a danger of it repeating itself here.

BvA: Which actually brings us exactly to where I wanted to end this podcast, before I started, which is this new department of science, innovation and technology, so it's another churn in policy, frankly, probably with a vison about how we should think about these kind of things.

But my question to you, Richard, is let me put it this way, we can talk endlessly about whether this is the right or wrong thing to do, in the government fabric, but, you know, on the one hand you hear all this rhetoric and you're write about it in the paper about, you know, the UK needs to be a science superpower and, you know, things like that and on the other hand, we all know, particularly from a productivity perspective, that science and innovation is about hard economic power, it's about diffusion oriented policy, it's about regional transmissions and everything that we talked about.

So I think my question is, if you look at this kind of reformulation of a new department, is it more likely to get us towards becoming the science superpower? Is it more likely to get us to become a harder economic power? Or is it more likely to get us nowhere in terms of where we already were? What's your thinking around it?

RJ: I do think it's potentially positive, you know, I think there needs to be a two way connection, if you like, between the state and the scientific community

and the state's priorities ought to be democratically determined, because that's the kind of country that we are.

But that transmission needs to be two way and it needs to be very wide ranging and, so, you know, getting down to the nitty gritty, about who spends money on science in the UK government, you know, quite a lot of it is not, in fact, the agencies that are going to end up in that department. Loads of it is going out through health and social care, loads of it is going out through the Ministry of Defence. I think, you know the Department of Levelling Up Housing and Communities ought to have a view about local economic growth.

So if it was to work, it would work because it was able to both communicate to the scientific institutions and communities, you know, what the state needs and, as I say, the needs of the state being informed by what people think is important, because that's what representative democracy should be about. And then, likewise, the various bits of the state that are charged with doing things, like, defending us and keep us healthy and keeping our economies working and keeping communities prosperous, should equally be learning from this department about, you know, what science can do for them and then equally informing our how scientific institutions communities about what their priorities should be. So it could work.

I think there is still that tension that we haven't really go a department for economic growth, that's separate from our finance department and I think that is always a tension. So the treasury has to be a very important department and if it was a little bit more focused on long term investment and what it needs to do to create sustainable growth as well as stop worrying about the budget balance, we'd be in a better place.

BvA: Yeah. And that will get us in a whole different debate where we'll probably also will do another podcast about it, we did one about it last year, but, certainly, it's a topic to be continued.

Look, a lot of content covered here, thank you so much. Thanks to Richard Jones, to Diane Coyle for this conversation and hope to see you again soon on one of our podcasts.

Again, a link to the report Science and Innovation Policy For Hard Times, you can find in the show notes for this podcast, as well as a few other links for work that was mentioned during the podcast.

Now, our next episode of Productivity Puzzles for March, will be on another type of investment, not in science, but in people and especially in people with intermediate degrees. The Productivity Institute has done a piece of research that will be published next month on the role of further education colleges and how they function in the local and regional settings where they are based.

How do these FE colleges work with business, with the community? How do they ultimately train up the people with the right intermediate skills that can help firms and places to become more productive? It's a great piece of work based on extensive review of existing evidence, but also 16 interviews with principles of FE colleges across England and it will provide some really interesting insights in what FE colleges can do and how they are doing it. And we will speak there with the researchers of the work, Jen Nelles of Innovation Caucus and Ben Verinder of Chalkstream and I will then be joined by another senior researcher of the TPI team, Andy Westwood, the Professor in Government Practice at The University of Manchester and an expert in education, skills and science policy.

You can sign up for the entire Productivity Puzzle series for your favourite platform to make sure you also don't miss any future episodes. If you'd like to find out more about upcoming shows, or any other work by the Productivity Institute, please visit our website at productivity.ac.uk or follow us on Twitter and LinkedIn.

Productivity Puzzles was brought to you by the Productivity Institute and this was me, again, Bart van Ark at the Productivity Institute. Thanks for listening and stay productive.

End of transcript