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Host:

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

Guests:

- **Sacha Wunsch-Vincent**, Head of Section, Economics and Statistics Division, and co-editor of The GII at the World Intellectual Property Organization (SW)
- **Anna Valero**, Deputy Director of Programme on Innovation and Diffusion (POID) and Distinguished Policy Fellow, Centre for Economic Performance, London School of Economics (AV)

BVA: How do we measure innovation and compare it across countries? And how can it be that the UK is doing so well as an innovation nation, while we seem to be underperforming on productivity? 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 I'm a director of the Productivity Institute, a UK-wide research body on all things productivity in the UK and beyond.

Welcome to the tenth podcast of Productivity Puzzles in 2023. Including this one, three more shows to come for this year, including a special one, which more about towards the end of this podcast.

In today's podcast, we are somewhat continuing on the topic of last month's show which focused on the Productive Business Index which is published by Be The Business. Those of you who listened to that podcast, and if you didn't then please go back there because it has some great panellists and a good conversation on it, but those of you who had a chance to listen will not have come away with a very encouraging view of the UK's productivity environment, because that index shows that the UK is in sixth position in terms of business productivity across the G7 countries, only leaving Japan behind it.

We did then discuss ways to improve things and much discussion was about the better use of technology and innovation and how that could change things, and that's exactly the topic for today's show. It's another index, the Global Innovation Index, but it focuses specifically on the role of science, technology and innovation. In 2007, the Global Innovation Index was first published by INSEAD, a business school in France, and received a lot of support from other organisations around the world, and since 2021, it has been put out by the World Intellectual Property Organisation.

Why does the UK do so well on the Global Innovation Index?

It's a global index, it covers innovation inputs and innovation outputs. It's composed of many relevant indicators for almost all countries in the world. And now we can deliver some good news because the United Kingdom ranks fourth on the Global Innovation Index, only behind Switzerland, Sweden and the US, but ahead of the other five countries in the G7, including Germany which is in the eighth position, France in the 11th position, Japan at 13th, Canada is 15th and Italy is 26th.

So we have another interesting productivity puzzle. How come we do so well on global innovation but why does that not translate into much better productivity in the UK? On 2 October, the UK launch of the Global Innovation Index took place in Oxford and I have the pleasure to speak about this with two of the presenters at that event.

Sacha Wunsch-Vincent is a Head of Section at the Economics and Statistics Division at the World Intellectual Property Organisation and he is the co-editor of the Global Innovation Index, so he can tell us about all the ins and outs of the Index, how we should understand the results and what it means for the UK. Sacha, welcome to this podcast.

SW: Thank you, Bart, for having us, and hello to Anna too.

BVA: Anna Valero is the Director of the Growth Programme and Distinguished Policy Fellow at the Centre for Economic Performance at the London School of Economics and she is Deputy Director of the Programme on Innovation and Diffusion. Regular listeners will know Anna is not new to this podcast as she was also one of the panellists on our podcast in May on a green productive economy and she's an expert in innovation, net zero and all its economic implications, so Anna, great to have you with us again today.

AV: Hi, Bart, great to be here.

BVA: Great. Well, Sacha, let's start with introducing the Global Innovation Index to our listeners, and who better than you to give us a brief crash course on this? As already mentioned, the Index consists of an innovation input index and an innovation output index, but there is a lot behind this, so lift the curtain a little bit to get us to understand what the Global Innovation Index is all about.

SW: So, indeed, this is the 16th edition of the Global Innovation Index. What we do is we use these 82 indicators to benchmark the innovation performance of about 132 economies, and at the same time, we rank the top 100 science and technology clusters. So it's a range of innovation indicators that mimic what we call innovation ecosystems to assess innovation performance over time.

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The use case for us is quite simple. More and more member states in the United Nations, OECD et cetera, are developing and crafting innovation policies but few are really able to monitor the impact of these policies over time. So for most of our member states, really close to 100, they use the GII to improve their innovation ecosystem, to see their strengths and weaknesses and then to overcome certain innovation weaknesses.

I mean, what would be interesting to you as well, and to Anna, I think, is it has become quite a powerful tool for improving innovation measurement as well. Because when countries are not covered in the GII or covered with many missing in our data, they become very keen suddenly on collecting better innovation metrics, and when I say keen, I mean, at minister or prime minister level, which really facilitates the speed of further on collection of innovation metrics.

So the three of us are quite interested, I think, in metrics, so it has been a real spur on collecting better innovation data.

BVA: That's actually quite interesting, because, you know, we can debate whether an index and the ranking of a particular country, what that actually tells us, but I think what you're saying is that just a focus on trying to put metrics together in order to get that index, that whole process of actually collecting these kinds of indicators is a good thing in itself, right, and I think that's very helpful.

SW: Yes, 100 per cent, and I can compare from my previous experience at the OECD, for instance, where convincing a member country sometimes to start collecting a datapoint, in particular middle income, low income economies, would have been really very hard, and here with this GII, the appeal to suddenly collect has suddenly risen, rising to high pay grades and then so many things go very, very fast.

In addition, what is appearing also is that countries use it to build cross-ministerial taskforces, where suddenly different ministers from different ministries and national statistical offices come together to pursue one whole of government sort of innovation policy. So you rightly say indexes as such maybe have meaningful contribution but they are not the end in itself, right?

So for us, the measurement part, but also this helping countries organise better innovation policies over time is critical.

BVA: Okay, so break this down a little bit for us, you know? You can't go through all the 83 indicators that you mentioned but if you look at the '23 release which just came out two months ago, what were some of the important findings if you break it down in some of these aspects of innovation?

SW: Yes, so in terms of the indicators as you say, we can't go through the 80, but some are quite classic, right, on the input side are the expenditures, for

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instance, venture capital availability, for instance, and then on the output side some classic ones like high-tech manufacturing, high-tech exports, productivity. But then we also try to innovate and go beyond the traditional high-tech view of innovation into the creative economy, into data on new innovation and entrepreneurship data, such as unicorns, right? So that's on the metrics.

Then in terms of the results, so there are two strands to this. First, we assess the global state of innovation, and for 2023, we came out with quite some optimistic and upbeat scenarios still, so most of our innovation and investment data, R&D, venture capital, scientific output, really are at historic highs still. I mean, you would have thought that with all that happened in the last three or four years, which is happening even this week, last week, et cetera, that we would see some downward impact on these VC investment figures, but that is not the case.

So it's generally an optimistic view to start with. But then when we turn our attention to future innovation investments, and this will be key to our discussion on productivity, there we are quite concerned. Early indicators on venture capital and any forms of future investments look down, you know, relative to 2022 and 2021. So it is no secret that inflation means high prices, high interest rates means you can't borrow enough money possibly, so on that one, we sent a warning signal to member states on Agence France-Presse called an innovation funding winter, so meaning we're entering from the summer into wintertime in terms of the availability of funds to fund innovation.

BVA: Yes, that's interesting, and it almost sounds like the problem that we will discuss in a bit more detail later for the UK, it happens in many places, so innovation we're still doing okay but because the translation in productivity and other performance indicators, you have a wider range of indicators looking at performance, that translation is getting more and more difficult and that of course puts up the threat that funding will go away.

Now before we get Anna into this question here, one more question about some of the ranks, because the ranks are kind of always cool to talk about and we talk about the UK in a bit of course, but what are some others? Because you cover so many countries, what are some of the other really interesting countries high on, but also some countries that perhaps are a bit lower than...?

SW: Yes, let's maybe talk about the top and then the movement a little bit, but in the top ten and top 20 even, there is some relative stability with Switzerland, Sweden, the US and the UK actually trading places sometimes among the top five but quite stably up there. And in the top 20, as you can imagine, it's mostly high income countries with one exception being China, which is a middle income economy, so the only middle income economy that makes it into the top 35 is China.

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Interestingly in the top ten, top 20, you have quite a mix of large and small countries, right? So you would have thought that it's only the US, but suddenly you have Singapore and Switzerland there, but you also have large countries, so it's quite an interesting message on how individual countries can find their sweet spot in the broader innovation landscape.

Then in terms of movements, in terms of regions, of course Europe and North America have always been on top. The only big regional upward move that's not a secret has been Asia, right, over the last ten years in the GII? So no surprise there. We do see some positive moves in Latin America, Brazil, Mexico, in the Gulf countries, which is relatively recent, you know, maybe testament to their effort to diversify, UAE, Saudi Arabia, et cetera. But also in Africa, where some of the countries overperform on innovation relative to their level of development, I'm thinking about Rwanda, Botswana and Senegal.

From a UN perspective, you know, our international innovation economics perspective, that is what we want, right? More systematic upward moves from countries outside the classic OECD type region.

BVA: Yes. Okay, Anna, thank you for being so patient, listening to this excellent introduction but you've been looking at this for a while, and as an innovation expert and economist, when you look at an index like that, what do you get from it and how do you think it can be usefully used in understanding innovation productivity and everything else?

AV: First of all, I think such indices are really useful because of the fact, exactly as we've been discussing, it's kind of an impetus to get the data together and to encourage countries perhaps that haven't traditionally been in, say, OECD datasets to improve their data. And I think Sacha just mentioned African economies having more comparable data on some of the innovation ecosystems in those economies is really valuable.

And I think, as you hinted at, there's the high-level ranking, you know, the UK being fourth, for example, but what's really interesting to me is the sub-indicators, so the 80 different indicators that underlie that, the categories that are covered, which go beyond some of the traditional ways we measure innovation, which we use because they're kind of well measured, things like patenting, things like academic publications, we have good datasets on those things. We can locate the documentation to specific places. We know the technology field or the discipline of study so there's really great data on those things. There are other areas that are harder to measure, so getting that impetus to improve data and compare data across things like intangibles, across creative goods and services, which are also really important for innovation and sometimes might not show up so much in patenting.

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So I think that's very valuable. I think this is something...clearly we've heard how policymakers are using this index and how it's shaping some of their activities as well. I can imagine for businesses considering expanding investment in different countries or investors, these also provide useful metrics, maybe not on their own but perhaps as a starting point to then explore things further.

And also, I think what's interesting as well when you're used to working with some of this data is that within this, there are a number of what is called kind of hard statistics, things like gross fixed capital formations, so capital expenditures, as a share of GDP, but also, I think most of the statistics are these types of hard measures but there's also some kind of indices from elsewhere, or survey based measures. And that's clearly delineated but sometimes it's those perhaps softer measures that are the only way you can really get a sense of something, given some of the data constraints.

BVA: So there are two worries that I have with these indexes, so one is that you only focus on the ranking, right? You know, the UK is fourth, look how fantastic we are, we're an innovative nation, blah-blah-blah, so you use it for promoting our strengths particularly not our weaknesses. The other risk is at the other end, you have 80 plus indicators and you just pick your favourites, right? And you say, okay, we do very well on intangibles and on creative output or something like that, but we do not fully understand the areas that we're weak on, we just ignore those.

So I think the question to me is how do we make sure that policymakers, but also other users, understand that innovation is a systemic issue. It is about bringing a lot of different things together and do them in conjunction, in harmony with each other. I think, Sacha, maybe starting with you because you mentioned earlier that one of the uses of these indicators actually is that different government officials in different departments do talk to each other. So how does it help us to really get policymakers and other users understand that we talk about innovation systems and not about individual buttons that you just turn up or down?

SW: Yes, great question. So to start with, obviously member states or countries prefer to highlight their strengths than weaknesses, right? So if they are more eager to flag a positive rank move or a good ranking. But that said, only a limited number of countries rank in the top ten, precisely ten, and then for other countries, if they are 30, 40, 50, 60, 70, 80, 90, it's clear that mostly their ambition will be to move up, right? So immediately the question is asked in a different way, and then the question is how do we move up and then the first meetings we have is on better understanding the measurement framework of the GII, but then very quickly we turn to strengths and weaknesses. This is usually closed door meetings and are rather sincere discussions on what can be done, lessons learned from other countries, and in the best of all cases, there's an action agenda formulated on the way forward.

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Now for me this is very important because...so when you try as an official like this, 100 per cent all the ministers will show you their great new innovation policy, right? So you get an innovation policy here, then a minister went to Silicon Valley and wants to imitate something there, and there's a flurry of these initiatives, sometimes every new minister has a new initiative but nothing of that is really looked at thoroughly over time, you know? And I think this is precisely where the GII helps, at least we have this agreement on strengths and weaknesses, it's written down, we agree on next steps and you can monitor the policy process over time.

And in fact, Bart, UK is number four, right? But in our meeting we had together in Oxford the other day, we discussed a lot of UK weaknesses, right, so even in the UK case I think a lot of the observers, because I mean, its observers also come in, the opposition maybe but also, you know, very bright academics, who then come in on the weakness side. So it's rare that I have seen countries rest on their laurels. Even the Switzerland who's been on number one spot for about 30 years or so.

BVA: Yes, if you're number one, you want to stay number one, obviously. Anna, any reflections from your end for this?

AV: Yes, I mean, I think obviously leaders of countries want to emphasise their strengths but in a sense this index isn't the objective function of a policymaker. The policymaker will want to have economic prosperity. I know we'll talk more about the UK but that's where we've had this persistently poor productivity and we also have a pretty bleak outlook currently but it's also well known that we have a lot of innovative strength, so in some sense, this overall index kind of reinforces that, but by no means leads to complacency. It's more about how can we actually do much better building on the weaknesses to realise that strength a bit better into economic success.

BVA: Yes, all right, well, let's go to the UK and share the exciting news that the UK comes in as number four. In a way, that doesn't come as a surprise because we're all aware of the strengths and the density of our science and innovation system, particularly our science system, I should say, and we have discussed that here but in fact we have dedicated a whole episode of Productivity Puzzles back in February on the science system in the UK with Richard Jones, so look that up if you're interested. But there's quite a bit of diversity though when you take the breadth of this innovation index. So Sacha, again take this through some of the highlights, where are the strengths? What makes it that the UK is so high up? But also, there are quite a few weaknesses and which are the ones that we are observing there.

SW: First on the ranking, so it's been stable at four. You say it's not a surprise, but four years ago, there were a few things that happened with Brexit and

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other important political choices where indeed, if you had asked people to surmise what would happen to the GII index ranking in the future, it might not necessarily be as certain that it would maintain number four, that there would be some impact.

And there are a lot of other things that happened, the pandemic, you know, the financial markets saw some changes from London to Paris and these sorts of things. I mean, for me, it's quite a strong result to maintain number four, although maybe it might not be surprising to you.

So I think it's a testament that over time the innovation strength has persisted.

So on the strengths, you mentioned the strong scientific and R&D base. It's no surprise that among the top universities, you know, the top ten four I think are in the UK with Oxford and Cambridge, et cetera, in it, but then when you look at other indicators that we use, those on venture capital, unicorns, and many other modern innovation indicators, the UK is doing really well as well. So it's a strong top R&D scientific base, many UK companies being among the world's top R&D spenders, and overall the UK is quite a high intangible asset intensive economy. At least the top firms are of that nature. We'll discuss later probably why this is quite concentrated and not geographically very dispersed in the UK but that's the overall situation.

In terms of the challenges, and to be short, we do see some investment shortcomings both in the terms of the level of gross capital formation investments but also FDI inflows. We see some issues with what we call the industry mix, the sector mix, right? So there's a lot of top firms in services, banking type sectors, but maybe a bit less in high tech, traditional manufacturing sectors. When you look at R&D, this is pretty much the same, R&D and financial services but also in the pharma sector, but much less in traditional manufacturing, high tech sectors.

In terms of the broader entrepreneurship policies and culture, so what is the room to create startups, we see some weaknesses there in terms of relative rankings, and also the way the UK enterprises, firms, use the research talent that exists coming out of these top universities. So we see this relatively low share of researchers and PhDs in UK enterprises which then also I guess goes to explain the low R&D intensity of some and possibly also declining intellectual property filing rights.

But this is in a nutshell and I'm sure Anna and you spotted more of those weaknesses and strengths.

BVA: Anna, does that align with your observations for the UK?

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AV: Yes, so I think that the findings in this index, to me they were quite consistent with a lot of my prior views, based on the work that we've done and that others have done in terms of the UK's comparative strengths and weaknesses. On the strengths side, as we've said, the world-class research that goes on in the UK's top universities and the very innovative companies that we are home to as well, also the skilled graduates being produced by our universities, many of whom contribute to either innovation or productivity in firms.

As Sacha said, you know, basically we are predominantly a service-based economy, the creative sectors are an area we have comparative strengths, finance, business, professional services, also. You know, manufacturing, high value manufacturing we do have comparative strengths in a number of areas but it isn't such a large part of the economy. In terms of employment, I think it's around seven or eight per cent. So, you know, one of the big debates is if we are thinking of a world where there is more of a desire to have supply chain security in countries, particularly with a net zero transition, can some of that strength in particular areas of high value manufacturing be expanded, and that's kind of an active debate at the moment.

But yes, the venture capital investment in the UK is an attractive destination for venture capital investment and high growth firms, so again that was picked up.

On the weaknesses side, I think crucially one of the indices is labour productivity growth and we see that the UK, I think it ranks 86th on that and this is clearly a weakness that we're all aware of. And underlying and contributing to that is the weak gross fixed capital formation to GDP ratio, which is again one of the indices.

But then looking deeper at some of the things that drive these core outcomes, as Sacha mentioned, there's some issues around the business environment. I think policy instability, we know that this is something that chills investment and we know that particularly in recent years we've had quite a lot of it, whether it's been through Brexit, whether it's been through political turmoil, but even absent those things, just perhaps the lack of a long-term plan or strategy that can give businesses some sort of certainty in terms of their investments. Again, as highlighted, there are well-known issues with skills where we do really well at the high end, there is this gap with too many people who kind of leave school and don't do something else. We released some new reports as part of the Economy 2030 inquiry looking into that last week and what a skills strategy for an economic strategy looks like, touching also upon the STEM issue and digital skills and the need to continue upskilling the workforce.

One thing I noticed was that I think there was missing data for the firms offering formal training which is one of the indicators for the UK. This is

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something that we know at least comparing the UK to its own past, there's been this decline in on-the-job training and given technological change and other sources of change, this is an area that we would predict needs to be rising.

BVA: I think that's a really good assessment by both of you. Just to be clear, Sacha, when I said that it's not surprising, it's particularly because of the well-performing science sector, and, for example, on citable documents, scientific documents, the UK is actually top, so that's very clear that the university system clearly is contributing here quite substantially. But I was struck by some other high levels as well. Software spending, very, very high, now that probably has to do with the fact that we have a strong business services sector in the UK and they obviously spend a lot on software so I think that was interesting, but also intangible asset intensity is important.

So to Anna's point, we're very weak on generic capital formation but when it comes to the intensity that we still have in terms of intangibles, particularly intangibles that are not typically measured in a national accounting system, you know, like management competencies and organisational competencies and all those kinds of things, that's where the UK still seems to be coming out very strongly, and we have a very large creative sector, and I think that creative output part is reflected in that as well.

But I think underlying it, and I think Anna also addressed this issue about the weak institutional system and the instability in that institutional system is of course striking, and I was struck, I have to say, by the very low performance of the pupil/teacher ratio in secondary education, which really...you know, there's 87 in terms of the amount of pupils per teacher, and that really also brings up the more generic issue that's being discussed in the UK a lot which is the underperformance of public services in general, not just education, but also health and so on.

So I think, yes, looking at all these things together by the three of us, it seems to be a sensible index. There's one question I wanted to ask you before we move on, Sacha, and that is that we have innovation outputs and inputs as we discussed, and there is a tendency for some people then to say, okay, if you're doing good on innovation outputs, because that is where the UK is very strong, but we're not so good on innovation inputs where the UK is weaker, you could interpret that as, well, that makes you very productive then, right? Because you put little in in terms of innovation but you get a lot out, and that makes you a very innovation productive nation, if you see what I mean?

But I think that's not the right interpretation of the innovation inputs and outputs, I think, right?

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SW: Some countries which I will not name, given my function, but...would love to have what we call a high efficiency in turning inputs into outputs, so there is a great number of OECD economies that Anna can name later on, or you, who have a huge problem in converting inputs into outputs, right? So they're really lagging and in fact most of the high income economies have that particular problem. The UK might be a little bit of an outlier in that respect. So you could, for a moment, rejoice in that high productivity, high input/output efficiency scenario as the UK.

That's one way of looking at it, a static way. If you look at this in a more dynamic way, for me the innovation inputs of today are the innovation outputs of the future, of tomorrow, right? And I see Anna nodding here, and when you see that, then it's not good to be complacent with this sort of innovation input and output ratio.

BVA: Yes, that's a great way of saying it, the innovation inputs of today are the innovation outputs of tomorrow, so it would be a very short-term perspective to say, oh, we're doing great because of the efficiency of our innovation process, that's a great comment.

Okay, we need to move on and talk about the implications for productivity but before we do that, we're going to take a very short break so you can hear what else is going on at the Productivity Institute.

Advert: The Productivity Institute is a UK-wide research organisation that is dedicated to understanding and improving productivity. Research covers a wide range of topics including business investment and innovation, skills and further education, foreign direct investment and trade, and the transition to net zero. The Institute also provides detailed analysis of productivity in the English regions, Scotland, Wales and Northern Ireland. Visit www.productivity.ac.uk to access the Productivity Institute's resources, including research papers, blog posts, insights and regional productivity score cards.

BVA: Welcome back to Productivity Puzzles, discussing the Global Innovation Index published by the World Intellectual Property Organisation and specifically of course the results for the United Kingdom and I'm doing that together with Sacha Wunsch-Vincent and Anna Valero.

Now before we go into the implications of UK's good performance on the Global Innovation Index for productivity, I'd like to briefly touch on one interesting chapter in this year's release, which goes below the country level itself and it looks at science and technology clusters. So this essentially looks at how the sum of patents and scientific publications tend to be clustered in particular places in a country, and that shows some really interesting results here, and particularly shows some interesting results for the UK, Sacha. So let's spend just a few minutes before we go into the

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productivity story about that science and technology cluster story and what you find there specifically for the UK.

SW: Yes, and I'm quite happy that you picked this part of the GII up. It's a relatively recent part and the methodological approach here is quite fascinating, I find. So rather than scouting existing national statistics and how they fit to particular cities or regions and then make up our minds what the top clusters are, here we really have a modern big data heavy IT coding infrastructure approach to generating these rankings. So essentially, we take a world map and we map with dots everywhere we see there is an inventor or somebody that publishes something, and then we see where all these dots are and by this we generate some sort of a bottom-up feeling on where the top clusters are.

So this is very different to us scouting clusters we know and trying to conform to certain existing governmental jurisdictions and so forth. It's really an innovative way of measuring innovation and I hope we can scale this up in the future. It's probably the future of big data innovation metrics measurement. Now in terms of the results, the last three years there was a major shift in the top five and top ten to Asian clusters, so the top five are now exclusively in East Asia with Japanese and Chinese and Republic of Korean clusters emerging. They are very patent intensive economies, Asian economies, and also, they have caught up dramatically in terms of scientific publishing, in particular China.

And then further down you have the usual suspects in the United States and Europe and sometimes we think Europe is out of the door and a thing of the past but that's definitely not the case if you look at the cluster rankings. And then beyond this, taking again a UN or broader international perspective, so quite eager to see what's happening in emerging economies outside of China, because we know China is doing okay, it's sort of a bit more timid in terms of the progress. Like Latin America, for instance, has just one cluster which makes it to the top 100, Sao Paulo, so there we would like to see a little bit more. None in Sub-Saharan Africa.

And the hopefuls here are India with four clusters which are growing quite strongly. This maps very well to the IP story, the intellectual property story that we see emanating from India. So India literally five years ago had a very low level of intellectual property filing, so high tech exports and so forth. It's had dramatic improvements in the last five years and that shows now. But then also I'd like to highlight the progress in Turkey, for instance, which you might expect because it's a known manufacturing entity.

BVA: Basically two parts to this, right? So one is the concentration of science and technology in a particular part, but then there's also an intensity index which basically compares the concentration of patents and scientific publications relative to the population. And there you've got two UK places in the top

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three, right? Not surprisingly, Cambridge and Oxford, Cambridge one and Oxford three.

And that's obviously very striking in terms of something that we discussed earlier also when we talked about citable documents and overall just on performance of science. So Anna, let me turn to you here and have you comment a little bit on this. If you take these two indicators, so one is an overall concentration index where Asia is just creating more critical mass around science and technology, but then in the case of the UK, if we compare it to the population, we still have real strength in a limited number of places. What does that mean for the overall UK science and technology environment?

AV: Yes, so I think Oxford and Cambridge, they are very important clusters in the UK and, as we can see here, globally, particularly when we normalise by population so the outputs that they're producing in patents and academic research and the quality of it as well when you normalise by the number of people that really stands out.

While London is further down on the intensity measure because it's just a massive city with loads of other stuff going on, I would also add it to this discussion in the sense that we tend to talk about the golden triangle of London, Oxford and Cambridge, which house many world-class universities, lots of innovative firms.

So, you know, let's just say that the innovation going on in those places is really important for those places and their own economic success but also for the UK as a whole, both through their contribution directly but also through all the spillovers. So this is something we measure through citations, so if you look at the spillovers of innovations in Oxford, Cambridge and London via citations to innovations in other parts of the country and indeed the world, they do really, really well. And so it was really great to see this analysis because we kind of use similar data and geolocate both academic publications and patents to try and understand some of these patterns.

Some of the work we've done at the CP and at POID was using this methodology developed by my coauthor Ralph Martin to estimate the returns to public investment in innovation, and we do this including these kind of measures as spillovers. What we've found for the golden triangle if we split the UK into this golden triangle of London, Oxford and Cambridge and the rest of the country is the returns to investment in innovation in the golden triangle is particularly high in areas such as clean technologies, clearly an area that's really important for the future in the UK and the world, both their own regions but also particularly high in terms of the spillover to the rest of the country. And this kind of importance directly and indirectly is something I'd want to emphasise.

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It also links to...maybe we'll come onto this...but some of the barriers to growth in the UK. We know that Oxford and Cambridge face planning barriers to growth so it's really hard even when firms want to expand their lab space, for example, it's very, very hard to do so. So the importance of building on those areas and addressing the barriers to growth is fundamental.

BVA: Yes, so the only thing that I might put to you here, Anna, is the question about is our science base, even though we have a strong intensity in Oxford and Cambridge, and to your point also in London, is it broad enough in order to create this spillover for the rest of the economy? So there have been some writings recently to say, well, it's all great, we're doing great in artificial intelligence and quantum technology and synthetic biology and so on, but there are only very few companies that actually directly work with the university system to turn it into new innovation and commercialisation.

So the question is how do we make sure that we really leverage that strength that we have in these few places to have the whole country benefit, not just in terms of productivity which we'll talk about next but basically in terms of broadening the innovation system in the UK?

AV: Yes, well, I think what's fundamental there is if you look at some of the strengths in terms of our academic research is how does that translate into the commercialised innovation which is then kind of expanded upon in firms that are growing and adding growth value added and jobs to the UK economy. And I think that's one area where it's been long recognised that there is an issue for the UK and various types of programmes such as the Catapult network to try and improve that industry/university collaboration.

I think there's more that can be done in that space. We have a project that's actually directly trying to measure some of this, so by linking academic publications into patents, we look at the extent to which research in different universities is contributing to innovations that are commercialised in patents, both in the UK and globally, and we find actually not surprisingly but Oxford, Cambridge, Imperial, UCL, they're the top four universities in terms of generating this kind of knowledge spillover into commercialised innovation.

But then you look at a country such as the US which on our measure kind of leads the world in this spillover from academic research into innovation, and it manages to internalise a lot more of that spillover into its own domestic patents as opposed to global spillovers. So more of our research is benefitting innovators globally, a higher share of that than kind of, say, America. And of course, that's great for the world, a lot of the research we're doing here is really important, whether it's on clean technologies, biotech, pharma et cetera, but from a growth perspective in the UK, the question is how can we leverage more of that excellence into value added and productivity here?

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BVA: Okay, let's now talk about productivity, because we promised that at the beginning of this podcast but there's so much interesting stuff to talk about. So of course, the weak productivity performance of the UK is a leading theme in this podcast series and we highlighted that also in last month's podcast when we were talking about the productive business index. But let's be a bit more specific where our strengths and weaknesses in productivity are because I think that's important to see how innovation links in.

I mean, productivity growth in the UK is slow and it's somewhat slower than in other comparative countries, but it's slowing everywhere, so there's a bigger problem around slower productivity growth. But even some of the other countries in the top index, I mean, Sweden and Switzerland, they have pretty slow productivity growth. But I think what's specific about the UK is the relatively low level of productivity. We're kind of in the middle of the pack of the OECD, perhaps even below the middle of the pack in the OECD, and that of course creates a problem in terms of resilience. If you have a low productivity level, it's just not good for the resilience of the economy.

So that also relates a bit to the structure of the economy, we have a relatively narrow manufacturing sector, we have a large services sector, some of that really good business services and we have these narrow regional strengths that we were talking about a minute ago.

So, Anna, if you take that sort of whole very quick diagnosis of the UK issue together, how does the innovation story fit into this and what is it that we need to change in order to really use that innovation strength to bring these productivity levels up?

AV: Well, yes, so on the invention side, so what we've been talking about in terms of all the great ideas being generated in universities, it's about commercialising that into firms, into products, here in the UK that can add to value and jobs. So that's a whole set of issues around how can we improve the flow of finance to scaling firms. You know, there was a Patient Capital Review led by the Government, there are various initiatives now looking at how can we get more, say, pension wealth into things like unlisted equities and high growth firms, because actually our pension wealth is pretty big but a smaller share of that is going to UK equities or unlisted equities than the equivalent in other countries.

We talked also about university/industry collaboration. For me, one other thing is, you know, the incentives, trying to align incentives, so academics often will be incentivised for longer-term outputs, so in top academic journals, business timeframes are different, how can you get some of those incentives aligned? Are there different ways of thinking of new career tracks for some academics who are more applied? You know, other countries

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have more applied science institutes such as actually Switzerland, and there's some great evaluations of some of those universities of applied sciences there.

And again, there are efforts in that direction here, and what you would never want to do, I think, is somehow diminish the role of basic science and the excellence there, but it's about on top of that can we do more to translate that?

On the other hand, there's the whole diffusion question, so how can we diffuse the technologies, the management practices that already exist that we know are very good for productivity through the economy, so this is more of an adoption story. When you look at the dispersion of productivity, we can see that those firms at the top of the distribution, their productivity has been growing since the financial crisis but if you look at the median employees working, that's where we see the stagnation.

So there's this big difference between the most productive firms and those in the middle, those at the bottom, how can we improve diffusion, how can we have dynamism? So there are various measures of business dynamism that show that this has been in decline both in the UK and other advanced economies. We need that process of creative destruction where new ideas, new firms offering those new ideas can grow and those that are less productive can kind of shrink.

So there are many areas that we've identified and others have identified as being barriers to investment, so barriers to investment in new innovations within firms, barriers to investment in fixed capital, improving management practices. We mentioned the planning barrier, I think planning is an important one. We mentioned finance, there's also things around corporate governance which could be improved here in the UK, so when you look at other European economies, for example, it's pretty standard for larger companies to have mandatory work representation on the board, this isn't the case in the UK. And there's robust evidence that shows that actually that kind of representation improves the long-term focus of management, and investment in longer-term value creation.

So there has been this issue in the UK of short-termism perhaps in the financial markets, in businesses, so how can we try and encourage that longer term outlet?

BVA: So you've written quite a bit about net zero and climate change and what needs to be changed there, and again we find that the UK overall has actually been, at least until recently, doing a fairly good job in that respect in terms of trying to be at the forefront both on the science and innovation side but even in terms of trying to implement some of the key measures in terms of renewable energy and things like that. How can we make sure that the UK is translating that strength into better productivity performance?

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AV: You're right, we have led in terms of our own decarbonisation, particularly in terms of electricity generation, and in our commitments. Of course, now there are concerns that some of those commitments are being diluted somewhat and that perhaps our strength in terms of global leadership on these things is also being weakened. However, we have lots of policies in place, and commitment from industry, commitment across the policy landscape in terms of the initiatives that are going on.

For me, the question is linking the deployment imperatives, so the imperative to get to net zero with actually realising the strengths that we have in connection with that, so as opposed to thinking of net zero separately from our growth story, it's actually thinking more of those two objectives in line with each other. Now UK firms, UK innovators are not specialised in every technology that we need for net zero, but our analysis has shown that we do have some relevant strengths in some key areas. So our innovators are particularly specialised in things like offshore wind technologies, tidal stream technologies, carbon capture usage and storage technologies. These are all things that are important for the UK's own decarbonisation story, so how can we more explicitly try to build some of that supply chain strength here in the UK? And in other new areas as well.

Another issue here when it comes to data is the level of aggregation you look, so you might look at a technology class such as clean cars, so electric vehicles, and you conclude the UK isn't specialised in such technologies, but actually when you take a deeper look at the relevant technologies that go into that, you do find that there are areas that UK inventors are quite specialised or where there's activity going on. And this is the kind of analysis that we've been doing which I think can be built on and replicated across different areas to try and inform such a strategic approach.

BVA: Yes, and I should perhaps say, I should have said that earlier, that of course in our show notes, as always, we will provide links, not only to the various documents from the Global Innovation Index but also from the work that Anna and colleagues have been doing on the Economic Inquiry 2030, so please go there to get all these links. Sacha, we need to wrap up but I want to give you the last word here, because last year when you published the Global Innovation Index for 2022, you actually spent quite a bit of analytical effort to make this link more directly between the index and what it would mean for performance and productivity growth in the longer term.

So what insights would you close on to sort of give the message to our audience on how the UK can best turn its innovation strength into better performance including productivity? What did you learn from that work?

SW: After all the bad news on productivity declines, we tried to send with you and the other authors a positive signal, right? So what are the two new innovation waves we called them that could restore what we called the

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broken link between innovation and productivity? So with the idea that innovation was a major productivity and standards of living driver in mankind/womankind, and asking, you know, what could be the two new things?

And we settled on two new innovation waves, one was called the digital age innovation wave, which hasn't started now, so the ICT equipment and infrastructure has been deploying for two to three decades, but what we mean there is more advanced uses of these ICT capabilities and mainstreaming these uses both in research but also across the whole of the economy including with new big data, artificial intelligence uses.

That was one. And the second one, which is conceptually and from a measurement perspective also harder to grasp, was what we called the deep science wave, nanotechnology, biotechnology, and all other deep scientific fields have generated a massive amount of breakthroughs over the last two or three decades, but they never really materialised into some sort of major new inventions, innovations which could be felt in productivity statistics. And so we feel that it's about time that this is happening and we see first signs of this, and sometimes it's actually precisely because of digital age and deep science waves actually mingling up and interweaving and fusing, in particular on the data end.

So this is something that I think, Anna and Bart, you and ourselves have to keep a measurement eye to, right? So how will this translate? Do we see any early signs? How do we have to adapt our measurement framework for this, right? Because maybe we are the culprits here in part. Then maybe let me conclude on an anecdote which links nicely to Anna's point. So I spent some time in Oxford and London over the last few weeks, I mean, twice, and I couldn't walk away with... I was very impressed with what's going on in the field of science in Oxford alone in terms of the future vaccines, malaria jabs and all sorts of different fields, so I didn't feel that the scientific fields of discovery were narrow but they were wide, and also they were matched increasingly to what we call these grand challenges, right? So food, security, climate change, et cetera, and I walked away with a very optimistic feeling.

But the problem I think is Anna's, right? The translation and also what firms in the UK and elsewhere have the absorptive capacity, it's a technical term for saying they can actually use that stuff, and make something out of it. So I hope that in deep science and digital age we will find these firms and entrepreneurs who will do precisely that.

BVA: Yes, so with last month's podcast on the productivity business index and this month's podcast on global innovation and the UK's position, I think we've got our homework carved out and we'll definitely continue to work on that and of course debate this in the productivity podcast series. But this was great insight from this Global Innovation Index, as I said, all the

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references and links are in the show notes. Sacha and Anna, thank you very much for this conversation, it was great and good to see both of you again.

SW: Huge pleasure.

AV: Thank you, Bart.

BVA: Our next episode of Productivity Puzzles will be a special one. As part of our National Productivity Week in the last week of November, we will be releasing a special episode on revisiting the productivity puzzle. What have we learned in the past few years about the causes of the puzzle? Have we seen any improvements or green shoots for the productivity recovery? And what should our priorities be for the productivity agenda in the coming years? In this new episode, we will focus on the national and regional productivity issues and we will do this with three panellists who have been key to the debate in recent years. We'll speak with Ed Balls, former Shadow Chancellor and coauthor of some recent great work on regional development, Andy Haldane, president of the Royal Society of Arts and one of the architects of the Levelling Up agenda and former chief economist at the Bank of England, and with Rachel Wolf, former advisor to Number Ten and now the director of Public First, a public policy thinktank.

I'm really looking forward to speaking with this panel and I hope you will join us for this podcast to be released in the last week of November.

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