Ep. 7 Productivity Puzzles podcast transcript

Can we still measure productivity in the modern economy?

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BVA: The one big question anyone working on productivity issues gets most is how do you actually measure it, how do we count what we make and can we capture everything needed to produce the products and services of today and can economists and statisticians keep up with the rapid changes in today's modern economy? We're going to find out. Welcome to Productivity Puzzles.

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

Hello everyone, welcome to this seventh episode of Productivity Puzzles and perhaps the biggest question anyone working on productivity gets; what is it and how do you measure it? And to be honest, that question is often asked with an underlying scepticism on whether you can actually adequately measure productivity. This podcast today will be a little longer than the usual 40 minutes because there's a lot to cover but I promise it will be worth your extra ten minutes of time.

Things were easy in the times of Adam Smith, one of the founding fathers of economics, talked about counting how many widgets we produce and how many workers we need to produce those widgets. But in today's economy, we produce a lot more than widgets and in Western economies, the manufacturing of goods is a much smaller part of the economy compared to all the servers we produce. Counting workers won't be enough, there are many different types of workers with different levels of education and different labour contracts and those workers have, in part, been replaced and in part been helped by machines, by new technologies' innovation.

And finally, not all productivity is good productivity. If we count increased efficiency of workers and machines but we ignore what it does to people's wellbeing or the environment, what do these productivity measures really mean? Those are big questions for which we need some great minds to help you understand those issues and explain them to you as much as we can in plain English.

Who are the great minds on our panel today? Our first guest Josh Martin and Josh is the Head of Productivity at the Office of National Statistics. ONS is a key provider of UK's productivity's statistics, is a partner of The Productivity Institute in improving our understanding and measurement of productivity. Josh will be leading us in the podcast by framing several of those topics that I just mentioned.

Just let me start with you, a very quick question and a quick answer. What is one of the best or the most interesting questions you ever received on the measurement of productivity?

JM: I think all questions on productivity are interesting but I think one of the most interesting ones I've come across is some work at the ONS trying to measure the productivity of the public sector where we don't have prices and we try and measure the output of education or healthcare or even defence. Sometimes I feel I'm part economist, part statistician, part philosopher, trying to do that sort of thing.

BVA: Okay, these things like public sector productivity, I'm sure we'll talk about today.

Next we have with us Rebecca Riley. Rebecca is a professor of practice and economics at King's Business School at King's College in London and she's also the Director of the Economic Statistic Centre of Excellence or ESCoE, another partner of both the Office of National Statistics and TPI. ESCoE is one of the main centres for innovation, economic statistics and improving productivity measurement is a big topic there too.

Rebecca, what's one of the most interesting insights that you and your colleagues at ESCoE have obtained from the work that you've done on productivity measurement so far?

RR: Thanks, Bart. Well, perhaps one interesting insight that we've found through the development of new business surveys is basically measuring where firms' expectations of their future turnover, employment and their expectations of macroeconomic performance.

And one of the things we've found is that businesses that invest in organisational capital such as better management practices are better at anticipating both their own and macroeconomic performance. And that should mean that these investments help firms to make better strategic

decisions, better input choices. It illustrates that one of the unmeasured things that affect productivity probably has quite an important implication for productivity.

BVA: In effect, it means that if companies invest in things like organisational capital and management, they actually get better at measuring it as well and understanding what it really means, that's really interesting. There's a positive loop here that we need to think about.

Finally, last but not least, we're joined by Jonathan Haskel who's a professor of economics at the Imperial College Business School. But in addition to that, Jonathan is also an external member of the Monetary Policy Committee at the Bank of England.

And from that point of view, Jonathan, I wanted to ask you what is the typical measurement questions you get asked or you have to explain in your Monetary Policy Committee meetings because they are important for policymakers to understand?

JH: Indeed, thanks very much, Bart. Let me answer that question by starting with your observation about Adam Smith. Of course, many listeners to this podcast will remember that Smith begins the Wealth of Nations with the pin factory, it's not the output of widgets, it's the output of pins that he's interested in.

And of course, what's fascinating about that is there's no evidence that Smith ever actually went to a pin factory, he gets all the details completely wrong. There weren't really many pin factories near where Smith lived, he lived with his mother for almost his entire adult life and didn't seem to get out very much. And therefore, the reason I say all that is the question we get as monetary policymakers is precisely that; are you guys and gals not getting out, they say.

Why are you stressing about low productivity when we're in the middle of a technological revolution, amazing cloud computing, fantastic ability of incredible machines to scan books when they're closed, to recognise the behaviour of consumers, to track where people are going and all those kinds of things, all those amazing technological changes.

Can you not see, is the script that people say to us, that there must be tons of productivity out there and therefore people want us to get out a little bit more.

BVA: Right, and that's what you're doing, I think, you are getting out quite a bit.

JH: We are trying to, with the pandemic it's difficult but we are trying to do a number of visits, indeed.

BVA: Yeah, better times will come for sure. Good, well, great to have you on and thank you for spending time with us. Josh, let's start right away, briefly describe to me how we move from counting pins, and Jonathan's correct, pins and widgets and workers to multiple outputs and multiple inputs and how does the Office of National Statistics deal with all those challenges over time?

JM: Yeah, we produce a range of productivity statistics to reflect the fact that there are lots of different outputs and lots of different inputs. The easiest one is to think about how much the economy produces as a whole, GDP, our total economic output in the country and divide that by the number of people that contribute to it, GDP per worker or GDP per hour worked, if you want to take into account people who work different lengths of time.

But then you've also got other types of input in the production process, it's not just people who make stuff in the economy, you've also got to use machinery and equipment, intangible assets and lots of other things besides. In which case, you might want to combine multiple inputs and make something that we call multifactor productivity.

But if you want to measure the output of a range of industries, not just pin factories and widget makers but all the services in the economy as well, we need some way of combining those things together.

And we typically do that and avoid double counting by using a measure we know as gross value added. When you think about a bakery and they use flour, if you were to count the output of the flour maker and also the output of the bread maker, you might risk double counting the flour there.

We subtract out costs that business pay where they're buying other business' output to make this value added measure and then account for changes over time so that we're in the real space, 'cause what productivity's really about is converting quantities of input into quantities of output. We don't care very much about our prices, it's all about the technical efficiency of turning x into y.

BVA: Well, that's a good start and I think you explained it at a really good high level for us to understand the multiple measures of productivity that you're having and the need to look at quantities and not just at values.

Quite often people say, well productivity is how much do I sell relative to what a worker produces. But that includes of course both the quantities but also rising prices which is another way to make money and that's not necessarily a part of productivity.

But let's deep dive a little and Rebecca, I want to start with you and talk a little bit more about the output side, right. One thing you always have to

know about productivity, it's about output and it's about input, what comes out and what goes in.

Let's start and talk a bit about what goes out. Of course, I already mentioned this issue of, you know, we're not just producing pins and widgets any more and stuff but we produce a lot of surfaces. And that's much harder to think about what that production exactly is, particularly if you think about quantities. Take us a little bit through some of the key challenges on the output side of measurement.

RR: Well, like you say, the rising importance of services in the economy around manufacturing and production is a relatively small part of the economy these days, has posed a huge challenge to productivity measurement. Yeah, we can measure apples and pears and manufactured goods relatively easily because they're comparable and they're comparable over time, they're homogenous, if you like.

Services, very different story there. You've got a much more varied set of products, for example, you'd have the haircut down the road versus the haircut at the fancy salon versus the haircut at the fancy salon with other services attached to it.

How do you compare all of these, they may have different price developments. Services are often bundled together, services may be provided with tangible goods.

Think of the way that we buy cars, for example. The car is a very tangible thing in some respects but it may perform very differently. Over time, there's been huge productivity improvements but importantly from the services side, you're often actually buying a service and an upkeep of a good.

Another complication with services is that many of them are publicly provided. Think about the NHS, for example, that means that they're zero price at the point of consumption.

Josh has already mentioned the importance of distinguishing between the quality and quantity versus pure inflation, which we're less interested in. And that becomes very difficult when you haven't got a set of prices to look at. That's one of the issues with productivity measurement and increased servitisation.

Another really big challenge in productivity measurement is how do we think of the nation state in a global economy? How do we draw the boundaries around value creation?

The classic example of how this is changing is the case of Irish GDP in 2015 which increased by 26 per cent which was very unusual and also completely different to what happened to household income, which rose by

five per cent at the time. And the main reason for this was simply a transfer of intellectual property within a multinational company. In the case of Ireland, for example, the result has been a move to having supplementary statistics to understand productivity.

BVA: Yeah, right, because there's a big difference between productivity of the multinational economy and productivity of the domestic or sometimes called a foundation economy.

One quick topic before I go on with Jonathan because I heard both of you talk about quantities and price in this quality element. It seems to me this quality element is really, really hard, right. You have to think about the quality element of a computer, the laptop has the same price but every time you buy a new one, it does about 100 times as much as before.

But this is true for many, many products, that quality is changing. Rebecca, can you give me maybe one example of really good ways to get around this quality problem. Because I think a lot of listeners to this podcast think you can never get a handle on trying to measure that quality well.

RR: Measuring quality is very, very tricky. There are technical ways of trying to pick that out of prices but examples of where this typically can go wrong is where we have rapid technical change. Because you get new products coming into the market, you have to feed those into your price statistics, technological advance may be very rapid.

For example, with telecommunications the world has completely changed in the last ten or fifteen years. There are different ways we can try and unpick that but the result is that you get quite significant differences between what you thought growth was when you didn't take these things into account to what growth then becomes. It also affects our understanding of not just the aggregate growth rate but also the composition of the economy.

BVA: Okay, well, we already went quite deep. We talked about outputs, we talked about various aspects of inputs. Just to let you briefly respond to make any reflection…very briefly, what kind of challenges has this given you on very practical measurement issues that you've recently dealt with and the way that you've improved your statistics at the ONS?

JM: Well, measuring prices and quality is indeed one of the most important and challenging aspects, as Rebecca was touching on. In a car factory, we're interested in the number of cars that are coming off the production line but not cars are equal and cars are improving over time.

A car today is not the same as a car ten years ago, even if they cost the same, there's more in a car today. We need to adjust not only for the price

but how the effective price has changed and we do that through adjusting for quality.

But in the case of a car, it's not just the prices of cars that are important here, we've got to think about the prices of the inputs to the cars as well, the steel and the software inside and the leather for the seats and everything else.

Something that we're doing in the official statistics now, introducing this year, is taking separate accounts of price changes of the outputs of places like the car factory and the price is of their inputs so that we can correctly account for different price changes in the economy and whether those price changes come from imports or activity in the UK, for instance.

Also making changes to the way that we measure quality change and prices in the telecoms industry, as Rebecca was touching on, which makes a really big difference as telecoms services are used so widely across the economy, both by households, by consumers, but also by businesses.

If we understand better about those telecoms services and what businesses are getting for them, it affects the output of one part of the economy but the inputs of the rest of it.

BVA: Jonathan, let me go to you. We talked about the output side, and as I said, productivity is always about an outcome and what goes in. Let's talk about what goes in and of course we already talked about workers and worker hours and I think one of us mentioned the importance of machines which we also need but there are many, many more inputs on the economy including some of those mysterious intangibles that we already mentioned a couple of times. Take us a little bit through what's happening on the input side, what do we need to think of?

JH: Indeed, Bart. Why don't I try, if this would help, with a concrete example. And I always think of the airline industry. It's difficult to remember airlines but way back when, before this pandemic, when we used to travel round regularly on planes and so forth, if you think of the evolution of the airline industry, go back to the airline industry, say, in the 1950s.

It was a pretty dangerous business carrying not very many passengers. You needed pilots, you needed wireless operators, you needed navigators, you needed lots of people to do it. In other words, you needed a lot of inputs for all those people and you didn't actually get much output, you didn't manage to carry all that many people very long ranges and it was very expensive to carry them a long distance.

Fast forward to the modern airline industry and we've got double-decked planes which can carry 500 people with just two pilots. One way of saying

that is to ask the question, does that mean the airline industry is incredibly productive?

And funnily enough, the economist's answer to that is, well, maybe not. And that may come as a surprise to people 'cause it would just seem completely obvious that we can carry many more people in comfort. But there it comes back, Bart, to your question about the machines.

The point is that the airline industry is using these fantastic airliners, in other words, amazing machines which used to be propeller driven and they're now jet driven. Maybe the productivity of the airline industry resides not in the airline industry but actually resides in the aircraft industry and the airliner industry, if you see what I mean.

The importance to economists of trying to measure the machines that are being used is the first way of having a deeper dive into productivity and trying to see where it is, that, as I say, those productivity improvements reside. And that's why the work that these statistical agencies that Josh Martin is concerned with is so important 'cause it relies on picking that.

If I can just take that example just a might further, you might then say, well hold on a moment, EasyJet, Ryanair, aren't they fantastically efficient, aren't they doing amazing things, getting people all over the place, and that, I think, takes one to the intangibles.

If you ask the question, what do EasyJet, Ryanair and Southwest and these low-cost airlines do, they use these very efficient airliners but they use them incredibly efficiently. How do they do that? Speedy boarding would be an example, there's an intangible notion.

There's an idea, getting people on really, really fast. It's an idea that's improved things, it's not a machine, it's an idea that makes the machine, namely the airliner, get full up more quickly. That would be one type of intangible idea that the airlines are very good at.

And the second one would be software. The obvious point about all airlines now but particularly the low cost airlines is they never bothered having very expensive travel agents and fancy offices and so forth, they wrote at a very early stage very clever software which meant that you could book very easily and rebook and change things and so forth. And again, software is an example of an intangible idea, namely not really a machine but bits and bites of code of being an idea.

As I say, I think that's why economists are interested in the inputs which contribute to productivity. We can then locate the sectors where we think the productivity is going fast, whether we think the productivity is going slow, and that's going to give us a much better understanding of how the economy's functioning.

BVA: Right, but your example of airlines is quite interesting and I think it's very well explained how we move from just lots of people to using great airplanes to using a lot of intangible capital. And then you gave the example of EasyJet or of Ryanair or whatever other of these companies you can think of.

But then you think, is this really the result of some kind of intangible capital or is it just a great entrepreneur who is just coming up with a great idea, it's just smarter people. What's the difference between smart people or human capital, if you like, and intangible capital?

JH: I think it's a question of where that knowledge resides. If Michael O'Leary, for example, were to stop being CEO of Ryanair, Ryanair would still know how to do the speedy boarding. They'd still know how to negotiate very cleverly with the various airports in order to get a good deal and to negotiate with the airliner manufacturers, Boeing, Airbus and so forth, how to get a good deal as well. It's tied up with all of that but I think it resides in the company.

But again, to your point, Bart, I think of entrepreneurship, which is often used in a rather loose way, and entrepreneurs as being the people who can bundle together a lot of these things, employ the efficient machines, motivate the workers, get the software written, do the negotiation, come up with the ideas. I think entrepreneurs have got the skill to push all those aspects together.

BVA: Yeah, and just ability, indeed, of entrepreneurs to codify the knowledge that they have so that it can be used, as you say, once they leave, I think that's why you would call it a separate piece of capital.

JH: Yeah.

BVA: Let's get a little bit more into why it's important to measure things well. The big issue of the day when it comes to productivity and we talked about it in previous podcasts extensively is a slowdown in productivity growth, not just in the UK, we see it in a lot of Western economies happening.

And that, of course, has raised the question, that's why I was asking all these questions on measuring quality and so on, are we perhaps just simply mismeasuring things or is there really a real slowdown happening?

I think, Josh, maybe quickly you can take us through the numbers and then we'll talk a little bit with Rebecca and Jonathan about how much of that productivity slowdown do we think is real and how much of this is a measurement issue. But tell us what the numbers tell us right now about the productivity slowdown, it's been the case over the last 15 years or so.

JM: Sure. The exact numbers depend on how exactly you calculate it, what time horizon you use and what numbers you put into the equation. But broadly speaking it looks something like this; the UK was growing in productivity at about two per cent per year for the decade or so before the financial crisis. In fact, longer than that as well, back since in the Second World War or so, productivity growth was a pretty consistent two per cent per year.

But since the financial crisis in 2008/2009, it's been about half a per cent a year. We've lost something like one and a half per cent growth per year in the UK. And over the course of a decade or so, that adds up to something like 15 per cent of lost output and all other things, lost wages and so forth as well.

And that number in the UK, that 15 per cent gap or the 1.5 per cent slow down per year, that is amongst the larger of major economies around the world, but that's not to say that other major economies haven't seen a slow down, most have.

The US has had a slowdown of something like 1.4 per cent, France 0.7, Germany 0.3. It looks like the UK is one of the worst affected but by no means the only one.

BVA: Rebecca, you've worked on these measurement issues for such a long time now, how much of that production slowdown would you allocate to the kind of measurement issues that we were talking about?

Are we measuring quality right, are we measuring prices right? Is this complexity of the economy? Are we perhaps not picking it up and therefore we're just measuring less productivity that we should?

How much of this is measurement issues, how much of this is real? Hard to put a right number on it but give us a sense or a flavour of what you think how important these issues are.

RR: First, if I could just add…I mean, I think Josh is absolutely right, how much productivity has slowed down depends very much on the exact timeframe you're looking at but one of the reasons this is so important is because productivity maps into living standards.

We've had productivity in the UK rising by something like 26 per cent every ten years and that maps very accurately to growth in average household incomes. Since the great financial crisis, living standards in the UK haven't risen nearly as much. But this is an advanced economy phenomenon. I've seen a slowdown in productivity growth across Europe, in the United States, but as Josh mentions, the UK has had a slightly greater productivity slowdown.

And one question then, is measurement the cause of this particularly poor performance in the UK. And what we see basically is that the sectoral patterns of the slowdown are very similar across many countries. And also in the UK and if you try to take into account differences in sectoral composition across countries, we don't find very much difference in what's happened in the UK.

The sectors that have slowed down very significantly are manufacturing, finance and the IT sector. And you could ask the question, are these sectors bigger in the UK and therefore the productivity slowdown is more severe in the UK? But no, that's not the answer but it is interesting to observe that these sectors, particularly finance and IT, are sectors where output is very difficult to measure.

You may think, well, there is something to the measurement story here. Lots of work has been done on this and I don't think anyone is suggesting that what we're seeing, the productivity slowdown, is purely a measurement artefact and I wouldn't suggest that. However, it probably does contribute something to the story.

One question, again you could ask, since the productivity slowdown is concentrated in these hard to measure sectors, you could also ask the question whether measurement is different in the UK to other countries in these sectors.

When we've looked at these types of questions, looking at, for example, how quality adjustment is taken care of in some of these hard to measure sectors, we find that that doesn't appear to be the reason for a sharper slowdown in the UK.

It's an avenue for further investigation, I think, just because people have been looking at it for a while, I don't think we have a very clear answer of the exact magnitude other than to say that it's part of a complicated story.

BVA: I'm going to be a bit of an advocate of the devil here, right, and I'll bring in Jonathan here to deep dive a little bit . You made the point on the finance sector, relatively large sector in the UK economy. We had massive amounts of rapid innovations in the financial sector in the decades before the financial crisis and one might argue that that's been one of the reasons we actually ended up with the crisis.

Since then, things dramatically changed in the financial sector. It's quite a good starting point and a hypothesis to say, that must be a bigger measurement issue in the UK and it might've played a bigger role in explaining the rapid rise of productivity in the financial sector and a bigger slowdown after. Jonathan, tell me why that is not a good hypothesis to confirm?

JH: Well, I think it's a perfectly reasonable hypothesis, Bart, but the numbers just aren't quite big enough. I mean, it is true that the financial sector is slightly bigger. It's also true we haven't mentioned north sea oil. We've got more north sea oil than other continental countries, although of course the US has got fracking and oil and so forth as well.

It is true, I think, that there are a couple of sectors where our presence is larger and the productivity both measurement and possible slowdown is possibly larger. But they're just not big enough to account for all of the difference between the different countries. I'm quite sympathetic to the challenge there but as I say, it just doesn't seem to be there in the numbers.

BVA: One final question to you and maybe also to Josh, maybe both of you can comment. What kind of scenario would you see emerge where you would say, that would radically change the story of measurement?

I think, economists, and I'm with you because I've been involved in some of this research too, would say, look, yes, it's important, we're working on it, we're doing our best. Measurement is not going to explain the productivity slowdown but what kind of radical change in the economy or our thinking about the economy might actually have more than marginal effects on measurement?

JH: There, I'd be bound to mention a little bit on intangibles, these intangible investments which companies may well be making in the teeth of a very big technological revolution such as we're going through around now, we're around artificial intelligence and cloud computing and so on.

They are very hard despite Josh and his colleagues' best efforts. Those are very hard to measure and maybe it might turn out that there has been something very badly going wrong.

I think that's unlikely, I think the difficulty with that and I'll finish on this, the pandemic is yet another big challenge. The measurement difficulties that we had I think have been somewhat overtaken and possibly obscured by the difficulties around the pandemic.

BVA: And we're going to pick that up after the break but before we do that, Josh, you want to wrap this up before we take a quick break?

JM: I certainly wouldn't say that measurement isn't a potential contributor to the slowdown, I think the economy is difficult to measure and increasingly so. But it would be quite some coincidence if all national statistical institutes across the world simultaneously got substantially worse at measuring the economy and productivity all at the same time.

Although it's a problem and one we're alive to and work hard to combat, I think it's just one of many issues and I know in previous podcasts, Bart, you've covered some of those issues as well.

BVA: Yeah, but it's important also when people look at productivity figures over time, to realise that we are making these improvements to the statistics and we try to work them back over time. But, you know, there can be breaks in the series, so be careful when you use these productivity statistics and think hard about all the changes and improvements that statisticians are making.

I said after the break we'll talk about the pandemic and what that did to productivity but we'll also take a little bit more of a look into the future on what's going to happen to improved productivity measurement even more. See you after the break.

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BVA: Welcome back to my discussion with Rebecca Riley, Josh Martin and Jonathan Haskel on measuring productivity and all the things that come with it. And one of the things that came with it one and a half years ago was a pandemic which we, in the productivity field, haven't really experienced, at least not in our lifetime, on how that would impact productivity and it had a very large impact.

Interestingly, a lot of things in the pandemic went wrong and got worse, the economy declined by almost ten per cent and things like that but productivity actually increased a little.

Actually, it didn't get much worse in terms of the long-term trend. And that's been a bit surprising and Josh, you've been working on this, of course, also, at ONS where you produce quarterly productivity numbers. So these

numbers became very volatile during the course of 2020 and the pandemic but overall, how can it be that the economy dropped by ten per cent but productivity still went up by, what is it, by 0.4 per cent in 2020 over 2019?

JM: Yeah, well, of course, again, productivity is a measure of outputs and inputs although output fell by ten per cent, so did input, so did hours work, not employment because of the furlough scheme but those people on furlough not working hours, our measure of input there fell considerably, in fact, fell a little more and hence productivity actually rose over the course of the year.

But this is largely a statistical artefact, it reflects something we call the allocation effect, the fact that different parts of the economy grew or shrank at different rates.

You can think about productivity for the whole economy as something like an average across all the different industries that are present and some industries are high productive industries and some are low productive industries.

The ones that shut down, temporarily at least, tended to be the low productivity industries like hospitality and food services, some parts of the retail industry, arts and entertainment and so on. It's like trying to take the average height in the room and all the short people walk out. Of course, the average height goes up but not because anybody actually grew.

Without taking into account this allocation effect, productivity actually would've fallen, we've seen that in the industry numbers, the average industry has seen lower productivity. But the UK as a whole has seen an increase largely because of its composition.

BVA: Yeah.

JM: But you're right to say that the data's been very volatile during 2020 and particularly difficult to measure. We like to keep an eye on that longer-term trend.

BVA: Yeah, and if you go the ONS but also the website of The Productivity Institute, we have some work there that's looking at each quarterly productivity numbers and try to show how this allocation effects are playing out.

Jonathan, let's dive a little deeper. One of the interesting things, of course, during the pandemic is that the way we're producing things, particularly services, change quite a bit because people start to work from home, were asked to work from home and not come to the office.

We had a lot of things that we were using in the office as inputs into our production process, didn't take it with and we've now certainly started to work from home. And you've done some work with some colleagues on the question, okay, but if you go home, what kind of inputs are you using then and are we actually measuring those inputs? To what extent has the pandemic had an impact on what we're picking up in terms of the inputs that are going in?

JH: Indeed Bart, and to set the scene just a little bit, you mentioned the changes in GDP. I mean, one of the big changes in GDP was between last year's quarter one and quarter two, just went the first lockdown came along. And there, GDP on a quarterly basis fell by about 15 per cent.

But if you look at the number of people who were sent home and weren't at the workplace, that fell by around 30 per cent. On standard assumptions, that would tell you that GDP should've fallen by about 20 per cent. Actually, it didn't fall by 20 per cent, it fell by much less, by 15 per cent.

One of the ways of asking the question is to say, why was GDP actually so resilient, why did it fall by so little? And the answer is, people started to work from home.

Well, what were they working with? We think they were working with capital at home and going back to the pin factory, that sounds really strange, right. In the pin factory, the whole point of going to the pin factory was all the capital was there, you had to go there, you couldn't do it at home.

But now, as your questions and our discussion has illustrated, we move towards the service sector, people are more able to do service sector activities from home. And that then gets you to the importance of industrial composition, which Josh was just talking about, but also the importance of communication capital so that the internet…

And the way that we can communicate much more readily are much more important as giving us the potential to produce feasibly output from home in a way that we couldn't do in the era of pin manufacturers.

BVA: Right, yeah, and what's interesting here about this working from home, and that's the whole debate right now, is to what extent is that going to stay, are we going to get some sort of hybrid working model. In the longer term, we might have a change in inputs in the production process and some of them may be in our office and workplace and some of them may be at home.

Rebecca, the other part of the discussion related to work from home, of course, has been better use of digital technology. You already talked about the measurement issues around this but also people are saying that maybe we now get this big uptake in productivity growth because people are just much better in terms of using their digital technology.

Can we be sure that we're going to pick that up and that not again later on people are going to say, well, it was there but you economists, you statisticians just didn't pick it up, you didn't measure it properly. What's happening with the digital adoption and the changes in that respect?

RR: Well, I'll get to that in a moment but I just wanted to point out that there are actually endless measurement challenges in measuring productivity over the course of the pandemic year, both in terms of getting responses to surveys and as Josh has alluded to, the measurement of how much labour's being used.

But also, the quality adjustment and prices. When we have things that we can't buy anymore 'cause we're in a lockdown, for example. And then, of course, there's business turn and composition as well.

I think one thing to bear in mind about economic statistics, no matter how well statistical agencies around the world have adapted to the pandemic and producing statistics at this time, is that they come with an added set of caveats and I think that's one thing to bear in mind.

In terms of technological change or adoption of digital technologies, which very much goes hand in hand with the home working thing, like you say, one story is that the pandemic has spurred innovation and the adoption of these technologies.

And we're aware that it's quite difficult to measure the use of these technologies as it is, that may or may not appear immediately in the statistics, I think there's more work to do there to measure these inputs, the data construction, the software use, the use of cloud computing.

These technologies are, to a large extent, missing from our statistics and there are changes that need to be made to actually adequately measure them. Eventually we will capture them in statistics, I'm sure.

But one of the interesting things that we found as well is that when we looked at our surveys, it that it appears to be that firms that are already doing relatively well have adapted better, both to home working, to online sales, to use of new technologies.

One of the legacies of the pandemic may not simply be a spurt in innovation, which eventually shows up in the statistics, but it may also be a greater dispersion in performance between the worst and the best performing firms.

BVA: Yeah, and that's a really important point, when we think about a measurement, it's not just about the macro number and it's not just about the industry numbers but it's also about the productivity performance between certain cohorts of companies and whether we see that smaller

companies or companies in different regions in the UK or in other countries are catching up and converging towards the leaders and that's, I think, a very important part of the story as well.

Before we go to the last section, let me quickly ask each of you, do you think…it doesn't have to directly relate to measurement but I know that our audience is interested in as always, do you think that the pandemic can actually really change or will change the productivity change, what's your best guess at the moment?

Will the pandemic help to see the productivity trend go back up or do you think we are probably going to exaggerate this or think more of this than what will really happen? Rebecca, let me start with you.

RR: I think the main thing that I would say is that the pandemic has led to structural change which will be ongoing. And it's not clear how that's going to go and there'll be further structural changes even once the pandemic has resolved itself and that will have implications for productivity.

BVA: Josh?

JM: Well, the ONS isn't in the business of forecasting but I can certainly give you my personal view which is I'm an optimist in this space, I think businesses will have learnt a lot through the pandemic through necessity. Necessity is the mother of invention and I think a lot of those lessons could prove to be very positive for productivity in the long run but we'll have to wait and see whether or not that comes through in the data or not.

BVA: Right, and Jonathan, you'll also definitely speak on a personal title here, what do you think?

JH: I'm optimistic, Bart, about the trend in some ways because I think what the pandemic has shown is that there's the potential for productivity improvements via digitisation in health and in education and those are two quite big sectors, that makes me optimistic.

What makes me more pessimistic, however, is that we haven't mentioned Brexit at all and we've still got the Brexit effects to be worked out. Those are overall productivity reducing for the economy, the balance of those two forces is a hard one to call.

BVA: And I think you've already given us one topic for one of our next podcasts, that's Brexit and productivity, I may invite you for that one again. Let's go to the last section here very briefly. We talked a lot about how to measure productivity and what's been done and how we're dealing with issues like quality changes but there's still an agenda there in terms of improving productivity measurement.

Josh, maybe you can start because I think the issue here is, to some extent, what do we measure in the economy when we talk about future productivity, are we measuring things that are part of today's GDP or do we want to make GDP broader than that or are there even some aspects that would really require rethinking of the concept of what an economy produces. What is your agenda at ONS at the moment in terms of improvements in productivity measurement?

JM: Well, we're always improving our productivity statistics in a number of technical and less technical ways. One of the things that I think is interesting to reflect on is all of our official productivity statistics are grounded in how we measure the economy and that is GDP.

Some people have referred to GDP as man's measure of the economy because it excludes a huge amount of work and contribution of people at home who, at least traditionally, have largely been women.

This household production of caring and cooking and transportation services and much other besides isn't part of the output measure of GDP. If you were to account for it and expand GDP in that way, you might also need to increase the inputs to balance those things out, but you might get a different picture.

Likewise, lots of other things that we've talked about here, measuring quality changes is part of the GDP framework but some types of intangible assets go beyond the international guidance.

There's also issues around measuring the environment effectively but if the environment is an input but also both positive and negative outputs on the environment of economic activity.

You can think about GDP as one end of a spectrum and you can add things to GDP and perhaps even take some away to get round to a measure that's closer to welfare or some sort of measure of wellbeing.

And some work that I've done with colleagues at the ONS and papers we've written for the ESCoE suggest there's an opportunity there to develop a spectrum of measures which might give us a little bit more reading on the economy.

BVA: Rebecca, where do you see most of the mileage in terms of future productivity measurement, where can we make the biggest gains in terms of improving the measures further?

RR: Well, I think a lot of the things we've talked about are very important for improving productivity measurement. The intangibles, the issues around globalisation, issues around capturing a digital economy and also public

sector measurement, I think that there's many areas where there's a lot to be done.

And I think also if these are addressed, there will also be a better alignment between GDP, the output measure we're talking about and these other, broader measures of welfare.

Addressing…one of the reasons we think there may be an increasing disconnect between GDP and welfare is because of economic changes which make it harder to capture output and measure productivity. I think if we address this array of issues, we will get better alignment between economic growth and changes in welfare, at least in some instances.

And of course, the big question now is also around the interactions between the economy and the environment, as Josh has already mentioned, there have been some advances there in trying to measure environmental inputs as well as outputs.

And I think some of the big questions there…I mean, this is a very, very tricky area but an important one, obviously, and one of the big questions there is how do we measure the externalities from economic activity on the environment?

BVA: Jonathan, let's pursue this a little further and it's almost a little bit philosophical about how long can we go on with expanding the concept of output and inputs of what we're including, right.

If we go back to the times that modern GDP statistics were invented under Kuznets and Richard Stone, we had a very clear understanding of what production was. But I think over time we have become increasingly confused about what production is and what needs to be included. And environment, of course, is a clear example because, to some extent, what is good productivity versus what is not good productivity, good output versus not good output.

I think the question to you, and as I said, perhaps a little bit more philosophical is can we just go on extending the concept of output and input forever and is there not a point that at some point it becomes almost meaningless?

JH: I think it depends what you want to do GDP measurement for. If you want to do GDP measurement for some approximation to welfare, I think one has got to face up to the very difficult boundary issues that Josh was just mentioning so that if I help my children do their homework, that's not GDP 'cause that's production that I'm doing in the home and that seems to be a great difficulty. That would tell you that you want to be expanding GDP.

Equally, I think one of the very important points about GDP and the reason why it's so difficult a job that the statisticians have to do is you don't want to be double counting.

Again, if you'll forgive me going back to the airline example, we don't want to count the productivity of the airlines and the airliners because the airlines use the airliners.

Keeping a grip on the value added notion of GDP is incredibly important, otherwise we'll go very badly wrong. And that's, of course, the reason why the whole thing was invented, because in the 1930s, when economies were grappling with terrible depression, economic depression, I mean, they didn't know how to stop double counting and therefore it was very difficult to get some sense about what the economy was actually producing.

BVA: Yeah, lots of topics to discuss in the future and Jonathan, you already had your chance and voted for the next topic could be about Brexit and productivity and we'll keep it on the list.

But I want to give Rebecca and Josh a chance as well. What would be your favourite topic to deep dive a little bit further into measurement issues around productivity issues, Rebecca, I'll start with you.

RR: That's an unfair question because there are many very interesting areas. I would focus on the intangibles, globalisation and digitalisation and I wouldn't want to pick one above the other, I think they're all important issues to address.

BVA: Three more podcasts to come but we'll make it happen. Josh?

JM: Well, I think the issue for me that would be relevant and really important, especially with COP26 coming up is the trade-off between productivity and protecting the environment, a topic that's incredibly important for all of us and one where I think there's just the start of some really important research.

BVA: Well, I admire all three of you for explaining these complex issues in very simple terms and I'm sure that our audience has benefitted from this. Jonathan Haskel, Rebecca Riley, Josh Martin, thanks very much for joining us today and talking about productivity and the measurement issues around it.

JH: Thank you.

RR: Thank you.

BVA: In our next episode of Productivity Puzzles, we will go back to productivity practitioners and in particular how to achieve productivity transformation

within the firm. This podcast will be on practical productivity and for that I will sit down with Mark Logan, a professor in practice at the School of Computing Science at the University of Glasgow. Mark has over 25 years of leadership experience in the IT industry, among which his stint as a CEO of Skyscanner.

In my discussion with Mark, who is also a member of The Productivity Institute Scotland Productivity Forum, we will focus on practical solutions, allowing you how to equip yourself with the knowledge to analyse and address problems you may encounter as your business grows.

Join us or better even, sign up for the Productivity Puzzles series through your favourite platform to make sure you also don't also miss any future episodes.

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