

Business, Energy and Industrial Strategy Committee

Oral evidence: Automation and the Future of Work, HC 1093

Wednesday 3 April 2019

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Members present: Rachel Reeves (Chair); Vernon Coaker; Stephen Kerr; Peter Kyle; Mr Ian Liddell-Grainger; Albert Owen; Mark Pawsey; Antoinette Sandbach.

Questions 100 – 195

Witnesses

I: Mark Richardson, Chief Operating Officer, Ocado; Vinous Ali, Head of Policy, TechUK; Brian Palmer, Chief Executive Officer, Tharsus.

II: Professor Sir Christopher Pissarides, Regius Professor of Economics, LSE; Dr Daniel Susskind, Fellow in Economics, University of Oxford; Dr Anne-Marie Imafidon, Stemettes.

Examination of witnesses

Witnesses: Mark Richardson, Vinous Ali and Brian Palmer.

Chair: Thank you very much to the three of you for coming to give evidence today on automation and the future of work. We have two sessions this morning. The first is on automation in business. I very much welcome the three of you to give evidence to us this morning. Time is of the essence this morning, because many people want to be in the Chamber at 11.30. We will start with Ian Liddell-Grainger.

Q100 **Mr Liddell-Grainger:** Mark, on automation, you said, “We want to build a general AI that understands our business model, that understands our data taxonomies and has oversight of our end-to-end platforms”. Can you explain that, please?

Mark Richardson: My goodness. I will try. What Paul, who made that submission, is getting at is some software that can oversee the state of our business. This is software that can spot if something is going wrong before I could spot it or someone who works for me could spot it. He is imagining a situation where some software monitors everything and perhaps can send us an alert to say, “In this warehouse, you are not getting as many orders out today as you need to. Maybe you should go and have a look at it”. It could help us optimise the movement of our robots in the warehouse. It could maybe help us optimise the mix of products we are promoting on the website today. That is roughly what he means.

Q101 **Mr Liddell-Grainger:** I think you are the biggest non-retail online company in the world. Is that right?

Mark Richardson: We are the biggest online-only grocery retailer.

Q102 **Mr Liddell-Grainger:** Yes, I thought I had read that somewhere. Given that, what is your percentage increase on automation? Your company has made the decision to go down the route of moving from a human doing it to a robot doing it. Can I call it a robot?

Mark Richardson: Yes.

Q103 **Mr Liddell-Grainger:** What is the increase in productivity and the percentage increase in the company’s revenue, dare I say it?

Mark Richardson: How can I start there? The automation situation is a little bit complicated, because there is no part of our operation where we use robots instead of people in their entirety, if you get my drift. What the robots do is they enhance the operation. They do part of the job. We always set out to use automation, by the way, because we were trying to do something that is very hard to do without automation. Doing it without automation is famously very expensive and leads to inaccuracy and so



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on. We did not decide to automate at some point in our journey; we started with the vision to be automated from the beginning.

To give you some sense of it, if you took our warehouses in total, the productivity we get through our warehouses is approaching double what you could achieve if you had not automated. It is very hard to compare us, because nobody really does what we do at our scale from a non-automated warehouse, so there is no direct comparison. You could draw some kind of comparison with those who do what we do from shops.

Q104 **Mr Liddell-Grainger:** You joined in 2001, did you not?

Mark Richardson: I did.

Q105 **Mr Liddell-Grainger:** That was right at the infancy of automation in many ways. The AI was in its infancy, et cetera.

Mark Richardson: Yes.

Q106 **Mr Liddell-Grainger:** You said that is what you set out to do, but your vision at that time must have been totally different to what the reality is now, just because of technology increases. Has that changed the way the company has looked at automation in the 18 years that that has been the case?

Mark Richardson: If I describe to you how automation seemed to us perhaps at the start, obviously there was a good deal of automation in the industry already when Ocado began. I suppose the biggest change is that we learned how hard it is to do that well. It is possible to seduce yourself into the idea that you can just go and buy it and then everything will go twice as fast. That is definitely not what happened in our case. We spent 20 years and millions of pounds trying to optimise the automation that we had originally bought and that these days we make ourselves.

I would say that automation at our scale is difficult. It requires a lot of focus and quite a lot of patience. I am not here to do a sales pitch for Ocado, but now, of course, if you want to do what Ocado does, you do not have to spend 20 years figuring it out; you can buy it from Ocado. The state of the art marches on because some organisations invest for the long term and create automation solutions that others can simply buy and deploy.

Q107 **Mr Liddell-Grainger:** Can I just ask one last thing? You had a very devastating fire recently.

Mark Richardson: We did.

Q108 **Mr Liddell-Grainger:** It was well reported. What did that do? Did you have to bring in people to do what the robots did? Did you manage to create enough capacity to continue?

Mark Richardson: The fire was obviously quite traumatic for Ocado and especially for the people who were working in the Andover warehouse. Effectively, we lost that warehouse. Roughly two-thirds of the capacity



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that we lost in that fire we are doing from our other automated warehouses. We were able to increase their output to compensate, not completely but largely.

Mr Liddell-Grainger: That is impressive.

Q109 **Mark Pawsey:** We know what Ocado do, because you are a household name and you very kindly directed us to a video that shows us how your picking robots operate in an automated warehouse. Mr Palmer, we do not know about Tharsus. Can you just tell us a little bit about your connection?

Brian Palmer: Tharsus designs and manufactures advanced machines and robots. We do it for a range of businesses.

Q110 **Mark Pawsey:** You are a supplier of automated and robotic systems to businesses.

Brian Palmer: That is correct.

Mark Pawsey: What I am interested in is return on investment and how long it takes to get a payback. What would your guidance be to a business looking to install the systems that you operate? How quickly should they get their money back?

Brian Palmer: We work with companies who want to own the technology, so they are not buying off-the-shelf standard robotic arms from people such as Kuka and Fanuc, which you see in a car company in the body shop or the paint shop. In general, if you are looking to develop technology and apply it to your business, there is a very long payback cycle. There would be many years of upfront investment before you start to see the commercial payback, but you are generating know-how and IP, which gives you a competitive advantage going forward.

Q111 **Mark Pawsey:** If there is such a long payback period, why should businesses do it?

Brian Palmer: They do it to generate that IP and know-how, which gives you a secure competitive advantage going forward. It gives you a long-term competitive advantage. A lot of the companies we deal with and that we talk to now are facing threats through the rise of technology, the scarcity of resource such as labour. If you are in logistics or retail, it is the rise of Amazon. The world is changing very rapidly, and you can see that businesses that have invested technologically ahead of the curve—

Q112 **Mark Pawsey:** Are you saying that they have to do it because the others are?

Brian Palmer: Yes, fundamentally.

Q113 **Mark Pawsey:** There is a competitive driver there.

Brian Palmer: Yes.

Q114 **Mark Pawsey:** Mr Richardson, what is your payback period? When you



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invest, how quickly do you expect to see a return compared to other methods of doing this?

Mark Richardson: Like lots of organisations, it depends on the project. For some of our projects, we need them to pay back within one year. If we are building a warehouse full of automation, it is not realistic to pay back so quickly and we allow it to mature over a much longer period. It might take three years to take one of our warehouses from its beginnings to running at roughly its full capacity and full productivity. Somewhere in that third year it is probably paying back.

Q115 **Mark Pawsey:** Ms Ali, could you talk about the business case for this investment for businesses across the UK? One of the things I was struck by from a previous evidence sessions was when the managing director of Fanuc told us that most businesses believe that the cost of automation is rather higher than it actually is. Is that your experience? How do we get businesses across the UK to investigate more thoroughly and implement these changes?

Vinous Ali: Yes, absolutely. It is really interesting to look at a company like Ocado. They are incredibly innovative; they are making their own robots with Tharsus, et cetera. For the majority of businesses in the UK, particularly the small and medium-sized enterprises, you do not have to have custom-made automation in order to get into the game. There are a lot of off-the-shelf products that you can simply buy and implement. That reduces the cost considerably. The other thing is that many of these companies offer free trials. You can try it out and see whether it works with your company and your ethos and whether it works with the other products that you are using. If it does not, you can fail fast and move on to the next thing.

The point was about how the cost of implementing these types of products is coming down. First, the cost of robotics is falling, generally speaking, but when we talk about automation we are not just talking about big pieces of machinery; we are often talking about subscription services or moving to using the cloud or CRM systems. A lot of the UK's businesses at the moment do not use those very basic systems, which could increase their productivity and do not come at a huge cost.

Q116 **Mark Pawsey:** The Committee would be interested to know why not. What is holding British businesses back from making these investments? Ocado clearly are, and Tharsus have a great range of products. Why are businesses not adopting faster?

Vinous Ali: That is a really good question. If we solved that, we would probably solve the productivity puzzle in its entirety. There are a number of different elements. There is obviously the cultural element of boards not really understanding the technology being developed, et cetera, and therefore not prioritising that. There is the fact that sometimes you can buy a piece of tech and it does not fit in with everything else you have. It does not work and therefore you go, "Okay, we will scrap this and go back to the old way of doing things".



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What we have seen, which is a really interesting point to consider, is the fact that if you are a new business you are more likely to use products and services such as cloud or CRM systems, et cetera, from day dot, which makes it much easier to build it in from the very start.

Q117 Mark Pawsey: You are saying it is harder for an existing business to implement rather than Ocado starting off, from day one, as Mr Richardson has just told us, with an automated process from the beginning.

Vinous Ali: It is harder to implement in the sense that you will have legacy issues that you will have to overcome, but it is more about the culture. If something is working well enough, there is an attitude of, "If it isn't broken, don't fix it". It is for Government and industry to do better at explaining how these tools and products can help and making sure that we have that cultural shift in the management's mind to understand exactly what those products can offer you as a business.

Q118 Antoinette Sandbach: I just wanted to follow up with Mark on the payback period. I know someone else is going to ask you questions about your development of technology, but, at the point when you were developing it, were you assuming you would be able to sell that on, or was that an added bonus?

Mark Richardson: That is a very good question. I would say that some earlier generations of Ocado's automation were developed pretty much entirely for us, with little thought for making them available to other retailers. For the latest generation of automation, we definitely had in mind that there would be plenty of customers for that if we could perfect it, yes.

Q119 Albert Owen: On the same theme, in your first response you said you were a retail company. Are you really a retail company or are you a technology company?

Mark Richardson: We definitely have always thought of ourselves as both. A fair observation might be that the emphasis has shifted a little bit in recent years from the retail to the technology, partly because the technology is becoming more visible because Ocado is promoting it. But we are clearly both.

Q120 Albert Owen: Is most of the technology you use today bought in or is it in-house?

Mark Richardson: Our latest warehouses use almost entirely technology that is developed in-house, much of which is manufactured by Tharsus. In some of our previous generations, we bought machinery from companies that make good machines, and what we typically did was we began learning the ropes in automation by writing our own software to run somewhere else's machines, which is already a slightly more ambitious approach perhaps than some would take, where you take the machine and the software.



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Q121 **Albert Owen:** You made the statement that others can buy it from you. Ms Ali was talking about availability elsewhere. Is yours an innovative product? Yes. Is it an expensive product compared to the market?

Mark Richardson: There is not really much of a market for what we do. You would expect me to say this, but I actually think our product is the best-value product in terms of anything even remotely like it that you could buy, if you were a very large retailer.

Q122 **Albert Owen:** Ms Ali, I do not expect you to say exactly the same. Can the automation technology industry here in the UK be a world leader? Is there enough R&D? Are we moving in the right direction or are we reliant on companies like Ocado?

Vinous Ali: We are absolutely moving in the right direction. The industrial strategy that has been put forward by Government provides a framework to help do that, particularly the sector deals such as the AI sector deal. We have a really good mix here. We have centres of academic excellence and innovative companies like Ocado operating here already. Fingers crossed, depending on what sort of migration system we end up with post EU exit, we will have the ability to bring in that sort of really highly skilled talent. We have all the right ingredients, but it is about how we can make sure we maximise that potential.

One other thing to add on this point is that we should not necessarily be aiming for every company out there to be the next Ocado. The problem is that at the moment we have such a long tail of companies that are not as productive as they could be and are not even using the basic digital tools that you would expect them to. For example, they will not have a website; they will still be doing invoices by hand rather than using software that can do those things for them. We need to make sure that we cater to the best, that really high-growth and high-performing sector, but we need to make sure we do that without creating such a big gap between them and the rest.

Q123 **Albert Owen:** On the world-leader aspect, you mentioned the industrial strategy, and there is lots of investment in R&D. What about manufacturing? Is that outsourced abroad and then brought back into this country?

Vinous Ali: The use of robotics in the UK lags behind all of the other G7 countries, and that is certainly something. You need to prioritise. For the UK, I would say the field of artificial intelligence and particularly ethical AI is somewhere where we could be a world leader. We should not be aiming to be a world leader in everything. It is about identifying where our strengths and talents lie and then building upon that.

Q124 **Stephen Kerr:** I might be the only person in the room who could not be a customer of yours, Mark, because you do not operate in Scotland, do you?

Mark Richardson: I am sorry. One day we will.



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Q125 **Stephen Kerr:** Two weeks ago, we published a report on sector deals and we called for specific action to support the retail industry. Can I ask a very general question? Does automation provide an easy solution for people-heavy industries like retail?

Brian Palmer: Clearly, there is some low-hanging fruit in automation. There is an increasing wave of easy-to-use automation tools and equipment out there. We work with a company that has just launched a very low-cost robotic arm, but one of the key things is not just the capital cost; it is the ability to use the software to program it. If you can use your smartphone or your iPad, you can probably program this robot. The barriers to entry are reducing. There are advantages to be gained there, but you have to be very—

Q126 **Stephen Kerr:** That is a no. It sounds like it is to me.

Brian Palmer: It is getting there.

Q127 **Stephen Kerr:** It is not an easy solution.

Brian Palmer: No, it is not an easy solution.

Q128 **Stephen Kerr:** Mark, is it an easy solution?

Mark Richardson: The picture is a little complicated. I started my career after university, an extremely long time ago, in the John Lewis Partnership. At that point, Waitrose already had an automated warehouse. It was not like an Ocado one, but they had already deployed automation. Automation has found its way into retail operations, particularly in warehousing, bit by bit, over all of the intervening decades.

Is it easy for them to go further? It is difficult to completely pivot your business into an automated business if you have an infrastructure of shops and existing warehouses. I suppose many of Ocado's competitors face a slightly different challenge, which is how to integrate automation into something that was conceived without automation.

Q129 **Stephen Kerr:** So without reimagining your business, the answer is no, it is not easy.

Mark Richardson: Maybe physical automation is difficult. However, software automation is available to everybody. In the long run, maybe some of the more startling advantages may come from software automation and artificial intelligence rather than from machines that move boxes around.

Q130 **Stephen Kerr:** Do you have a different answer?

Vinous Ali: No, I completely agree with Mark on that one.

Q131 **Stephen Kerr:** Ian mentioned the fire, and that does cause me concern, having had a background in business. Disaster recovery is something that is well rehearsed. What happens in a situation like that when a business has a reliance on automation? You referred very quickly to what



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happened at Andover. My concern is the resilience of a business. What happens to that business when it goes up in smoke—literally, in the case of Andover? Disaster recovery is very difficult when you have put all your eggs into automation as opposed to people.

Brian Palmer: Any business needs to have a resilience plan and a disaster recovery plan. One of the key things every business has, as Mark alluded to, is that data, that software and that ability to operate. I do not really see an automated plant versus a non-automated plant as materially different. As long as you are protecting your data and you have really good failover plans in place, I do not see that you materially increase the risk with automation.

Q132 **Stephen Kerr:** Businesses that are heavily automated have the right resilience measures in place in the case of disaster recovery.

Brian Palmer: Even if you are not heavily automated, you should have the correct resilience plans in place.

Q133 **Stephen Kerr:** You would agree with that, Mark.

Mark Richardson: I would say that the additional risk is perhaps that the automation allows you to consolidate into fewer facilities. The risks that faced the Ocado business years ago were much higher, because we only had one warehouse. One of the reasons we are able to accommodate, if you like, the disaster in Andover so smoothly is because we have multiple warehouses. I do not think that the fact of their automation is much of a factor.

Vinous Ali: If I can build on that, there would be few companies out there that would either be fully automated or fully human; it will most likely be a mix. Therefore your processes for when things go wrong will be the same, regardless of the percentage mix that is in there.

Q134 **Stephen Kerr:** It depends on the nature of the business and the physical structure of the business more than whether it is an automated business. That is what you are saying in essence.

Vinous Ali: Absolutely.

Mark Richardson: I think so, yes.

Q135 **Stephen Kerr:** In terms of the jobs at risk, there all kinds of reports have been published, particularly in the last five years, that have a range of statistical analysis available, about the number of jobs at risk and the proportion of jobs at risk. Let me ask you, very simply, what the tasks are that you expect are most likely to be automated in the immediate future?

Vinous Ali: It is really interesting to read all of those studies, because clearly they have their hands on a crystal ball that I have not yet procured. There is definitely something in there.



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Take, for example, the process where an invoice comes in and you have to match it with a purchase order. If that is currently done manually, it might involve multiple staff. That takes a couple of days; it requires sign-off by someone in senior management; the invoice might get lost or damaged, et cetera. It is quite a routine and dull process to go through, but it is something that you absolutely need to do for your business. It is those types of tasks, ones that are routine and fairly repetitive.

Q136 Stephen Kerr: Does that tie in with Andy Haldane's comment about how the jobs that are most at risk from automation tend, on average, to have the lowest wages? There is the figure of £30,000, which has come up in relation to the new immigration White Paper as well. Anyone earning less than £30,000 may be in a job where—

Vinous Ali: I can point to a number of teachers and nurses who earn less than £30,000, and I would argue that their jobs are incredibly skilled and are unlikely to be automated any time soon.

Stephen Kerr: That is a very good point.

Vinous Ali: It is those repetitive tasks that do not require much human creativity, et cetera, that are likely to be automated. What I would say is that there are very few jobs out there that rely solely on that alone. Therefore, we are talking about the automation of tasks rather than jobs as a whole.

Q137 Stephen Kerr: Does automation automatically lead to a reduction in jobs? You may have suggested there that it does not necessarily.

Vinous Ali: It does not necessarily lead to that. There is certainly job displacement, and the jobs themselves will change. Your job description might look slightly different, but we are a long way off jobs being completely replaced by robots. That is not to say that people will not need to adapt in terms of their skill sets, et cetera. The reskilling and upskilling challenge that is facing us as a country is something that we absolutely need to tackle head on. That is the challenge.

Q138 Stephen Kerr: That is the challenge—future-proofing our workforce. Brian, do you have something different to say about that?

Brian Palmer: Yes. We see a lot of companies that are struggling to access labour in sufficient quantity coming to us, looking to automate their processes. It was reported last week that a lot of the growers in UK agriculture, who rely on seasonal pickers, are estimating they are going to be about 25% understaffed this year. There is a material threat to their businesses going forward. We are working on some agri-tech projects.

Q139 Stephen Kerr: This is raspberry and strawberry pickers.

Brian Palmer: Yes, as well as lettuce, celery and all sorts. You have quite a low-value product but you have a very short pick season, so you need to be able to flex your labour force. The other area we are seeing is



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what is often referred to as “dirty, dangerous and distant”, where you can use automation in environments where you really do not want to put people.

Q140 Stephen Kerr: Mark, what is the effect on the workforce of introducing automation? They see creeping automation. How does the workforce respond or react to that?

Mark Richardson: Interestingly, from our point of view, the automation is what has enabled us to hire so many people. Without it, there would not be anybody working for Ocado. We have increased the levels of automation each year and increased the number of members of staff each year. I would say we have a very positive outlook, as you would probably expect. The automation is allowing us to deliver a higher-quality product efficiently and sustainably, which is therefore enabling us to hire more people.

There are some tasks that existed for people to do when Ocado started that people no longer do, or largely no longer do, but those tasks were dismal tasks. They were boring, certainly repetitive and potentially mildly dangerous because of the continual repetition of the same movement. I am not aware of anyone in Ocado’s history ever having complained that we took one of those tasks away and gave it to a machine.

Q141 Stephen Kerr: Yes, as long as they kept their jobs.

Mark Richardson: Yes, as long as they kept their jobs, but, as I say, jobs have been rising in Ocado.

Q142 Chair: Can I just ask something here? Obviously, one of the jobs people talk about being automated in years to come is driving and delivery. Presumably a lot of the jobs you have created during your existence have been with a physical person delivering because you are growing as a business. Do you expect those jobs to disappear in the years to come?

Mark Richardson: If we take the general point, will some driving jobs disappear? I think that will happen, because one of the areas of automation that looks perhaps most fruitful is automated vehicles. Our use case is a bit complicated, though, because we want to bring the shopping out of the vehicle and deliver it to you. We potentially even want to bring it into your house and your kitchen, which is part of the service. Never say never, but that seems quite difficult to automate. I do not anticipate a reduction in the number of drivers in my organisation any time now.

Chair: That is interesting.

Q143 Vernon Coaker: Can I ask a little bit about skills, training and those sorts of areas? First of all, if I can start with you, Mark, as your automation extends, develops and improves, what sort of retraining is offered to the people who work for you? How easy is it for them to adapt from what they were doing to what they are doing now?



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More generally, for the others on the panel, what should the Government be doing to support that in-work training? Should it just let it happen? What should be done to help and develop that? Can we start with you, Mark, specifically on Ocado, and then move more broadly across that retraining piece?

Mark Richardson: In our case, there are occasions when we need to train someone to use automation. Obviously, we do that. We give people thorough and comprehensive training.

Q144 **Vernon Coaker:** Do you do that sort of thing in-house?

Mark Richardson: Yes, we do it in-house. The other thing we do is we are very keen to give people the best opportunities that we can, so we try to make available to people training at various different levels that will allow them to broaden their horizons in the future and perhaps improve their prospects. Those sorts of trainings vary from specific on-the-job training in terms of delivering a very precise set of skills to supporting people to do NVQs.

We have a number of apprenticeships in Ocado. We make available to our staff training at a more general level: training to be a manager, training to learn a new language or training to learn technical skills. If someone comes to us who perhaps feels unable to take advantage of our automation—I am thinking more about software than machinery here—we are able to provide some training for those people to get them more confident and put them in a better position either to help us out in our journey or for whatever their next job is.

Q145 **Vernon Coaker:** What about the Government's role? As far as TechUK is concerned, what should be the Government be doing?

Vinous Ali: This is quite a long process. It is about where the Government should start now, what it could be doing today and how it can plan for the future. In terms of what it can do today, as Mark mentioned, Ocado do brilliant things. A lot of our members have their own training programmes. For example, Google, Sage and Salesforce all have training modules.

Q146 **Vernon Coaker:** Do they work?

Vinous Ali: Yes.

Q147 **Vernon Coaker:** I am not trying to be awkward or disrespectful, but how do you know they work?

Vinous Ali: Often those people will then receive promotions, get on a career path to do something different, et cetera. You measure it by the success of what that person who has received that training goes on to do next. They have their own programmes. Apprenticeships are a really good method of training people and upskilling them. There is already a lot out there, but industry cannot deliver at the same scale that Government can. Often people do not know that this free material is out



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there. Government can do something in order to signpost today to what is already available.

Q148 **Vernon Coaker:** Are they not doing that?

Vinous Ali: The signposting is quite haphazard at the moment. There is the Digital Skills Partnership, which is setting up local partnerships in a variety of regions across the UK, such as Coventry and Lancashire. That is really helping connect industry to the people out there who require the skills. That is something that can be built on, and we can start that now.

Q149 **Vernon Coaker:** It could be more co-ordinated.

Vinous Ali: Yes, it could be more co-ordinated. It is basically about putting people in touch with the right programmes that already exist out there.

Q150 **Vernon Coaker:** We often get this in different areas. Everybody is responsible, but who is responsible? Do you see what I mean?

Vinous Ali: Exactly, yes.

Vernon Coaker: Who do I ring? Do I ring Mr Smith on his number? Somebody goes, "No, you need this number". Is it a bit like that?

Vinous Ali: For example, you have the local enterprise partnerships, which act in a co-ordinating role and are somewhere where people who have some questions, whether that is a businessperson or whoever, can go and hopefully get some answers. With the Digital Skills Partnerships, that is what is being recreated there. It is somewhere where you can go for some information and some knowledge. They will point you in the right direction for how you progress.

That is something that can be done in the immediate and short term, but this is a huge challenge. Automation is something that is happening quickly. The rate of technological development and change is something we have never seen before. Often there are comparisons to previous industrial revolutions, but they were much slower to come to fruition. The challenge is enormous.

The National Retraining Scheme is a step in the right direction, but the level of funding it has received—I believe it is somewhere around £100 million—is not anywhere close to enough to be able to retrain an entire population. Adult education is something we really need to invest in. That also brings with it a cultural change.

Q151 **Vernon Coaker:** Brian, who would deliver adult education in the way that TechUK have just outlined? We all might be for adult education, but who is going to do that?

Brian Palmer: We really struggle to generate meaningful interactions with—

Q152 **Vernon Coaker:** We have had a really useful contribution from the two



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panellists on this, but the thing that always gets me is about who does it. Everyone agrees we should have adult education. It is absolutely fundamental, but who does it?

Brian Palmer: We do it internally. Unfortunately, it feels, from our perspective, like you have to solve the problem yourself. We are rolling back into the schools. We are just going through the process of employing an ex school-teacher who can actually go into local schools and talk to the teachers, educate the teachers and bring children into the business, exposing them to robotics and the like. If you want to have an impact, it feels like you have to do it as a business rather than relying on the Government or local education establishments.

Vinous Ali: There are two sides here. There is the adult education piece for those who are already in work and need retraining. Industry is already leading on that, and Government can play a role in pointing people in the right direction, to what is already happening. Then there is the whole question of how our education system, as it stands today, prepares our young people for the future of work? I know the Education Select Committee is looking at that issue.

Vernon Coaker: Yes, they are looking at that.

Vinous Ali: We need to make sure that we are looking at the entire pipeline and not just concentrating on one or the other.

Q153 **Vernon Coaker:** That is interesting. Brian, your point is that there is work going on with people going into schools, but business is driving that.

Brian Palmer: In our case, yes. We are working very hard to engage with local colleges, schools and universities. We have found that we do not really speak the same language.

Q154 **Vernon Coaker:** Who does not speak the same language?

Brian Palmer: Business and education do not. Locally, we struggle with that.

Q155 **Vernon Coaker:** Can you give us an example? Do you have an actual practical example? That is quite a big deal, is it not?

Brian Palmer: We are desperate to have an impact on the community in which we operate. We want to have a positive impact as an employer. We have come to the conclusion that the only way to do that is to be positive and go into schools. We are bringing a teacher on to our staff who can then go out to the schools and actually talk to teachers, explain what we do, how we do it and organise to bring the teachers in. It is not just about the head teacher or the head of careers. You have to get to the grassroots, if you like. That will enable us to bring children, and potentially their parents and teachers, into the business so they can see what modern manufacturing looks like.

Q156 **Vernon Coaker:** Very quickly, because I have run out of my time: what



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is the perception in schools, colleges or any educational establishment of automation? Do they see it as a positive thing, the future, a job destroyer or what?

Vinous Ali: To look not just at automation narrowly but tech more generally, often there is still the stereotype that exists today of, "If you work in tech you probably wear a hoodie and sit in front of about three different laptops staring at your screen all day. That is not the case. You do not even necessarily need to have a STEM background in order to work in the tech sector. As the economy digitises more generally, there will be a whole range of different types of jobs out there.

We cannot expect our teachers, who already have their plates full, to be able to explain that to children. If we are to get more women into tech careers and create a more diverse pool of talent to come in, it really is for industry to go in and show what a tech career looks like. For example, TechUK supports the WISE campaign, which is all about signposting the different types of jobs that will be available in the future and signposting women who already do those jobs, in terms of how they got into them. There are so many different pathways into a career in tech, whether that is via a degree or via an apprenticeship scheme.

Personally, for me, I would consider myself working in the tech sector now, but I have a degree in history. That taught me skills that are totally applicable, whether that is project management, creativity, leadership, teamwork, et cetera. All of those skills are absolutely relevant to a job in tech. If you are looking to create a high-skilled, highly paid workforce of the future that does not have to do the dull, dangerous and dirty work we alluded to earlier, it is those skills that will be of paramount importance.

Q157 **Albert Owen:** Following on, you talked about skills and you said the signposting was haphazard. Our inquiry will get a response from Government. You mentioned the industrial strategy, for instance. What more can Government do to help businesses invest more in automation and then become successful? You said we are lagging behind the rest of the G7. What specifically would your ask be? I will come to the others on the panel as well.

Vinous Ali: There is one big thing that TechUK is advocating for. It is really interesting to see what Government incentivises via the tax system. At the moment, for example, the Government gives tax releases to capex, capital purchases. If you are going to buy a server box, you can get tax relief on that. It does not have the same system built around opex. If you are talking about putting greater automation and buying software that is a subscription service, giving tax relief on that helps signpost to companies that might not have management boards or finance boards that are incredibly tech-savvy. If the Government are incentivising that, you might think to yourself, "That is the way we need to go". That is a fairly simple change, but it is one that could have a huge impact.



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Q158 **Albert Owen:** Mr Richardson, do you agree with that, or is there something you would like to add? What can Government do specifically?

Mark Richardson: I have little to say about direct incentives Government might provide to business to invest in automation. I do see an impediment to investing in automation. You can do a sum to determining whether it is a good idea or not. The reasons why you do not do it after you have done the sum are perhaps because you do not have confidence that you will get the result the sum produced or you are unfamiliar with the territory. I guess I would concentrate in the education so that people come out of school with an appetite to trust the maths and to want to be successful and efficient.

I find it somewhat frustrating that the arguments for automation, and software automation in particular, are often pretty straightforward: "If you do this, this is the result you will get". What is disappointing is that, despite the relatively straightforward sum you can do, people are still nervous or shy about doing it, probably because they lack confidence about them being able to get the advertised result.

Q159 **Albert Owen:** You were a pioneer 20 years ago. My question is whether, if you were starting today, you would know where to go for advice, help and support to set up a modern automated company.

Mark Richardson: I might come to Brian or me. Otherwise, I do not know where I would go, I am afraid.

Q160 **Albert Owen:** Do you have a role? Could you work with Government to improve productivity?

Brian Palmer: As a business, yes, we help companies improve productivity.

Q161 **Albert Owen:** Do you think you have the major role or should Government do more to help you?

Brian Palmer: It has to be business-led; Government cannot lead it. Ocado is very unusual in that they will define an outcome and, if that works, they will commit to it. We see a lot of large companies that are very operationally focused, and they really do struggle with that. They try to eat the problem in lots of small bites rather than look at the outcome: "Does that work? Yes, we will commit. We will challenge people to achieve that". That is the big disconnect. How can Government influence that behaviour?

Q162 **Albert Owen:** As a final question, we started off talking about tax incentives. Is there a need for reform in the tax system?

Brian Palmer: You can encourage; you can nudge. It does rely on businesses. R&D tax credits work well. I had not thought of the opex idea that Vinous was talking about. If you could look at extending the R&D process into the acquisition and usage of technology, which is clearly new technology, maybe you could encourage that behaviour.



Chair: Thank you very much to the three of you for coming to give evidence. It was incredibly useful. Thank you for your time today.

Examination of witnesses

Witnesses: Professor Sir Christopher Pissarides, Dr Daniel Susskind and Dr Anne-Marie Imafidon.

Chair: Thank you very much to the three of you for coming to give evidence this morning. You all heard some of the previous session, which I thought was very informative. We have about 45 minutes for the session. Members will be looking to go into the Chamber at about 11.30, so we will try to get finished before then. We will start this session with Albert Owen.

Q163 **Albert Owen:** Thank you very much. I would like to put to you a question that my colleague Stephen Kerr put to the other panel. There are all these statistics about job losses due to automation. What is your view on it? Do you agree with the TUC, which has suggested that it could lead to a four-day week, for example? Do you want to kick off?

Professor Sir Christopher Pissarides: I agree with the numbers, but I think they are a good thing.

Q164 **Albert Owen:** Explain that, please.

Professor Sir Christopher Pissarides: Yes, I thought you might say that. There are always changes taking place in labour markets because of technology. Imagine how many jobs electricity destroyed in steam power; imagine how many jobs the arrival of the car destroyed. All of these things are good things because they increase productivity and they raise living standards. Since 2000, Britain alone lost 27% of industrial jobs. That must be due to new technology. Even Germany lost 8% of industrial jobs in the 15 years after 2000. No one really panics or complains about that, because companies will replace workers with machines when they become more productive, when they become more profitable. Extending that to society as a whole, society will benefit.

The only reason we have worries this time that it might be different—and I think it will be different—is that the jobs that are under threat are jobs done by qualified, skilled people. In the past, the jobs that electricity destroyed or the jobs that the motorcar destroyed were unskilled jobs. The jobs they created, on the other hand, were also unskilled jobs. Whether you stand on an assembly line that is electrically powered or you are in a factory doing jobs using steam power, there is not much in it. You move from one to the other and you get it.

This time, the jobs that will be created—I believe there will be enough jobs created—will require a different set of skills from the ones that workers have now on the whole, much more than in the past. The challenge now is not to find the new jobs, and it is not the fact that there



will not be enough new jobs coming on, but that the workers who will be dislocated—it might be up to 15% or 20% over the next 15 years—will need to reskill themselves to get the new jobs. That is where the challenge is. It is not in the new technology.

On the four-day week, we know from evidence that the more productive a country becomes because of technology, the fewer hours they work if you look at it over the year as a whole. Most of the time off is taken as annual leave, not as reductions in the weekly hours.

If you look across the OECD, for example, the country that has one of the highest productivities, especially in industry, is Germany. The country that has the smallest number of hours of work over the 12 months is Germany. The second smallest is the Netherlands, and then comes Denmark and Sweden. These are the countries that are technologically advanced. That is a good thing. It is what labour economists have been talking about since the days of one of my first directors, Lionel Robbins. It is what you call the backward-bending supply curve: the more income you get, the fewer hours you want to work.

Q165 Albert Owen: I will ask the other members of the panel whether they agree with you, but was it not the case, when manual labour was reduced by automation, that many went to work in the retail sector? Now we are seeing the retail sector becoming automated. You said there is room in the leisure sector for the jobs.

Professor Sir Christopher Pissarides: Yes.

Q166 Albert Owen: Do you agree with that?

Dr Imafidon: I agree largely. To pick up on your point about retail and transport, we are seeing that. Those roles are also under threat, so there are two sides. The worrying side on that is that those are more traditionally working-class roles that are being replaced or that are most at threat in retail.

In terms of the four-day working week, there are a couple of things that will need to change culturally across the board before that can be achieved. It will be hard to legislate as it is. It is the kind of thing where we need to be more open about work quality, about pay, as Chris has hinted at, and also around work hours and how people take that work. The four-day work week has been interpreted as not working on Fridays or picking a day where you do not work, whereas it might be shorter days. It is that overall reduction in hours. That is possible.

In terms of the roles that are under threat, we have to bear in mind, which lots of the reports are quite explicit about, that it is not that the entire role that will disappear; for many roles it is elements of that role that will disappear. It actually means you end up having something that may be a little bit easier or a little bit nicer in terms of being able to go to a four-day work week or to reduce the number of hours as well.



Dr Susskind: I agree with the first part of what Chris said. In my view, the challenge is not that there will not be enough jobs. There will be jobs for people to do; it is just that they might not have the skills and capabilities to do them, as Chris said. That is the challenge in the medium term through the 2020s.

There is another part of it, though. What has become clear over the last few decades is that jobs have not only been created or not been destroyed at that end of the labour market, requiring certain types of what we might call high-skill work, certain types of capabilities. It is also the case that many low-paid jobs have also not been susceptible to automation: things like table-waiting, security work, cleaning. This is work that tends to be low-paid and insecure. The reason it has not been automated is quite interesting. It is because that work is non-routine, to use language that someone used before.

It is obvious that some of the work that lawyers, doctors, teachers and accountants do is non-routine, because it requires things like judgment, creativity and empathy, but it is also the case—it is known in computer science as Moravec's paradox—that many of the things that human beings find simplest to do with their hands we find hardest to automate. That tends to be concentrated in lower-paid and more insecure work. That is also a worry for me.

One of the consequences of technological change is not just going to be that there is work at one end of the labour market that people do not have the skills to do; it is that there is another part of the labour market that is also not going to be automated, and that work is probably going to be low-paid and insecure.

Q167 **Albert Owen:** We have been talking about a four-day week, but we have established now that it could be reduced hours. Is that going to have a positive or a negative impact on the economy?

Dr Susskind: There is a broader question about how the productivity gains of technological progress are shared. Is it reflected in the profits of the companies responsible for developing the technologies? Is it reflected in the pay packets of the workers? Is it reflected in the numbers of people who are employed? Is it reflected in the length of the working week? That is a broader question.

Q168 **Albert Owen:** In the past, we have had automation in industries such as steel and coal, and it has created mass unemployment. You do not see that happening now with the next automation revolution. You see it more as being seamless and in a transitional period.

Dr Susskind: Again, my worry is not that there is not going to be enough work for people to do, but that those displaced from the work they currently do either will not have the skills to do it or will have to fall back into work that is insecure and low-paid. The story is not one of mass unemployment, but either of those things would be worrying.



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Dr Imafidon: We will go through a transition phase. We will not have mass long-term unemployment. It will hopefully be medium or short term. It is about skills and allowing people to be able to retrain across. When we look at steel and coal, that did not happen on the scale it maybe needed to. There is also this sense that it will be a wider breadth of people who will need to have that retraining and that access to skills.

The ending point on the previous set of witnesses was about where people can assess those skills and where people can retrain. Do they know where to access those kinds of places? There is work that is being done by the DCMS Digital Skills Partnership looking at doing this across the country.

The other layer I would add is to make sure we have the right kind of provision geographically. That is the other thing that has happened with some of the unemployment we have seen already. Efforts are concentrated in particular areas where you already have employment and industry. If industry has disappeared from somewhere or it has been reduced, that is where we need to invest in making sure that people are able to retrain across the country.

Q169 **Albert Owen:** Christopher, do you agree?

Professor Sir Christopher Pissarides: I agree with Anne-Marie. I am even a little bit more optimistic than she sounded. The reason why we had big problems with steel and coal was that they were very localised industries. The workers lost their jobs there—take south Wales, for example—and there was nothing else that they could do. Automation is not like that. The jobs automation is replacing are not localised anywhere in the country; they are spread throughout it. London has as many, if not more, than outside London, because of routine data-processing jobs that are done over here.

When you have job creation going on in the country as a whole and job closures going on in the country as a whole, you have a better chance of matching workers to new jobs and retraining them, whereas in the past, with the big industrial declines in the 1980s and so on, you got into questions of regional mobility, housing costs and dislocating people. That is where the problem was with those industries.

Q170 **Stephen Kerr:** The word “skills” has come up quite a lot. There was an inference in your answer about what kind of skills people will need. Can you be very explicit about the kinds of skills you feel people need to prepare themselves for in terms of capabilities?

Dr Susskind: In my view, there are two very broad categories of skills. First, we can try to train people to compete with machines to do the sorts of things these systems and machines cannot do. There are lots of examples of this: certain types of interpersonal tasks, social skills, the ability to act creatively or the ability to solve problems.



There is a second set, though, which is then about helping people and training people to build machines and to be the sorts of people who are capable of designing and operating these increasingly capable systems and machines. Those seem to me to be the two sets of skills that we ought to be training people in.

Q171 **Stephen Kerr:** Did you have something different to add to that?

Dr Imafidon: It overlaps with that. To build on what Daniel said, there are things that human beings at the moment can do that computers and technology cannot do at the moment. It is the collaboration and the connection. Caring is the other one that we talk about as a growth area. We are looking at care; we are looking at teaching. Those are things that at the moment we are agreeing are going to continue and are going to be boosted.

Q172 **Stephen Kerr:** This is the interpersonal stuff where you need some empathy with the person you are dealing with.

Dr Imafidon: Yes, to be able to do that job well. That is teaching, social care or anything in that regard. The second one is the kind of digital and technical skills. At the moment, we are still lagging behind on digital skills. Digital skills themselves are not even just in creating. They are also in understanding and literacy—the digital literacy to understand what is happening. That is something people will need to do some of the new roles, even if it is exception handling. Understanding what these algorithms, which a lot of our work is looking at, are doing is also a basic skill that people need to be able to understand, but that also becomes a transferrable skill in terms of knowing how you learn.

Q173 **Stephen Kerr:** Are businesses doing enough to develop these capabilities within their existing workforces?

Dr Imafidon: Wholesale, no. There are examples of businesses that are doing well and that are using existing Government funding to be able to retrain. Frustratingly, the apprenticeship levy is being used by a lot of businesses to retrain people internally.

I know BEIS has had a number of these kinds of funds as well for training women in the workforce on technical skills. I do not know whether they are all doing it on the same level where businesses know that that they have to do compliance training or those kinds of things. We have seen this in the Digital Skills Partnership. They are not doing it as much. There is a concerted effort at the moment to try to get businesses to take that as a responsibility that they need to do.

Q174 **Stephen Kerr:** Do the Government have a responsibility to play an active part in this?

Dr Imafidon: I see it as the Government's responsibility to help make it a norm and to help reach places where business cannot, or at least to boost what business is doing at the moment. With these public-private



partnerships, we need to be able to expand those so that we have the availability but also the visibility on what is available.

At the moment, there are things that are happening in pockets that, if you are not in the know or connected, you cannot access. Work is one way to do that, but of course not everyone is in work or in the kind of work that has given them those skills, so Government might be able to help fill in with that too. We initially said it as the commission having a lifelong learning account or fund that people know they can draw down on to be able to access some of this learning and re-skilling.

- Q175 **Mark Pawsey:** Can I particularly focus on professional jobs? Daniel, you were talking about that, and we all know the challenge. With automation we can see a machine replacing the work that an individual does. You have done some work suggesting that that is happening. We are now seeing additional information being available challenging the role in medicine, normal teaching and audit. What is driving that and is it desirable? Will people still want people with specific knowledge and skills? Will the skill base narrow down because the general information is readily available? How is that all going to work?

Dr Susskind: What is driving change in the professions is largely technological progress. Is it desirable? It depends from whose standpoint you are asking. If it is a traditional professional, a traditional doctor, lawyer or teacher who thinks the only way to solve whatever problem they solve—legal problem, medical problem or accounting problem—is to do it the way that it has always been done in the profession, so in some cases since the middle of the 19th century, then it is quite troubling for them, because technology is allowing very different types of people and very different types of institutions to solve the sorts of problems that they solve.

- Q176 **Mark Pawsey:** A lot of those professions call for judgment. Are we going to get to a stage where judgment can be made?

Dr Susskind: Let me give you an example, because you are exactly right. Professionals often interrupt me and say, “Daniel, you do not understand. What I do requires judgment, and judgment is the sort of thing that can never be performed by a machine”. The question of whether a machine can ever exercise judgment is the wrong question to be asking. Instead, we should be asking what problem it is that people need solved when they go to professionals and ask, “Give me your judgment”. It strikes me that the answer to that question is because of uncertainty. The facts are unclear or information is ambiguous; the patient, client or student does not know what to do. They go to professionals and say, “Look, give me your judgment based on your experience and help me make sense of this uncertainty”.

In the case of judgment, the question we should be asking is whether a machine can deal with uncertainty better than a human being can, and



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the answer is that in many cases, thanks to advances in processing power, data storage capability and algorithm design, they can.

A practical example is a system developed at Stanford recently that can tell you whether or not a freckle is cancerous as accurately as leading dermatologists. How does it work? It is not trying to copy the judgment of a human doctor; it knows and understands nothing about medicine at all. There is a database of 129,000 past cases and it is running a pattern recognition algorithm through those cases.

Q177 Mark Pawsey: How about from the perspective of the consumer, so the person receiving the advice? The person receiving the advice is now capable of gathering more information themselves, but some would argue that a little knowledge is a dangerous thing. Therefore, is there a danger that people will try to eliminate the advice and end up making wrong decisions personally

Dr Susskind: My position on this is that from the point of view of the consumer and the client, the recipient of the professional work, these changes are on balance a good thing. They are a good thing because, if we are frank, the traditional professions are creaking. Not enough people have access to a good education and a good healthcare system; they do not know what their legal entitlements are; they not know how to manage their financial affairs.

The promise of a lot of these systems is making available far more widely expertise that traditionally has only been available at great expense to a privileged and lucky few. You are right: if the benchmark in judging these systems and machines is what the finest human experts are capable of providing, then in some cases I am sure they will fall short, but in many cases the benchmark is nothing at all, and that is why these developments are important.

Q178 Mark Pawsey: In your assessment, are the professions that we are talking about embracing this change or are they resisting it?

Dr Susskind: It depends on professions and places in the world. It is a mixed picture. I will say that when I began to start thinking about this set of issues and problems back in 2010, there was far more resistance to these ideas than there is today. There is far wider recognition that professional work is not immune from these sorts of changes and that professional firms and professionals have to respond to continue doing what they do.

Q179 Mark Pawsey: To move on to a separate issue, Vernon Coaker spent a lot of time challenging the previous panel about who is going to train people as their job roles change, and he drew attention to the lack of adult education. We had one business saying, "If we want to retrain people, we need to do it ourselves". Is that desirable? Should there be a role for Government there, Professor Pissarides?



Professor Sir Christopher Pissarides: That depends on the training required and the jobs available. The way I see it is that if you look at skills along the line, what automation does is that it opens a hole in the middle of that line, and then some workers will have to go in one direction and some workers will have to go in the other direction, and some will be doing jobs within the same companies but different jobs, because what automation is doing is to replacing tasks, not jobs as a whole. In terms of the task replacement and movements within the company, the company has to do the retraining because they are the ones who know their needs best.

Q180 **Mark Pawsey:** Is it right that the companies should bear that cost? If there is a broader societal benefit, should some of that cost not be borne by the state?

Professor Sir Christopher Pissarides: The companies should be doing it, but the cost should be shared somehow with Government. It could be shared in the form of tax incentives or even a direct allowance for training, if you think of human capital and the way they get allowances for their capital investments.

I do believe in sharing. The biggest part of the cost should be borne by the company because the worker would be producing and most likely be staying at the company because they are giving a very specific skill to the worker. There is always some general skill that is transferable, and for that Government should step in and do it.

There are a big number of jobs that would be created to take on those leaving. It would be in completely different sectors of the economy, like the hospitality sector and the health and care sector, and there you cannot expect a company to be doing most of the training. The training there should be borne mainly by the Government and mainly through the education system.

Q181 **Mark Pawsey:** Anne-Marie, do you think the Government should be doing more?

Dr Imafidon: I agree with Chris on that. The Government should be doing more in adult education in that space with a fresher push on it, since it is now more urgent and important.

Q182 **Mark Pawsey:** Where should that be delivered? Should it be delivered in the workplace or in colleges?

Dr Imafidon: It should be a mixture of both. The thing is that you have a lot of different people who are trying to be trained, and where they can learn the best and where they can access it the best differs depending on who they are, where they are at and what kind of work they are doing at the moment. You need a multifaceted approach for a very diverse population.



I wanted to pick up just a little bit on judgment and this sense of whether too much knowledge is something to be concerned about. The other side of that is also in the algorithms we have at the moment, and this was highlighted in our *Equality through transition* discussion paper. There is also something around judgments and how many judgments we have at the moment that are seen as fair or equitable, and seeing whether there is an opportunity, in taking things away from humans or supporting humans better with the algorithms we have, to ensure that we have equality through transition in the algorithms that we are using and the way that we are helping lawyers, doctors of whoever else it might be, but ensuring that we have the right data behind that.

At the moment we have asymmetric data across the population. If we are looking at legal or medical decisions, there is a lot of information that is not there. We have to be careful that we do not repeat some of the inequalities that we have seen in judgments already in the system as we then go into algorithms. We also take an opportunity to say that an algorithm needs to take an extra day to set, or we need to consider—

Q183 **Mark Pawsey:** That is a note of caution.

Dr Imafidon: Yes, it is a caution or an opportunity, actually, if we are going to do that, especially if we are looking across the health system and maybe the experiences of pregnant women for the baby community. There are all kinds of example where we still have inequalities across the system, and so we need to make sure that we either get ahead of that with the algorithms and ensure that we do not re-enforce that, or that we are able to use the technology in a better way and build better technology, maybe with a different set of people, to ensure that we get better judgments or we support people to make better judgments.

Q184 **Chair:** In terms of different parts of the labour market, there is some evidence that suggests that the jobs that are at a higher risk of automation tend to be performed by women. Is that your understanding?

Dr Imafidon: Yes, it is. When we look at some of the sectors that we mentioned earlier, anything that also has higher proportions of part-time work tends to have more women working across those sectors and in those roles.

Q185 **Chair:** What can be done to support people in general, but maybe women specifically if their jobs are at a higher risk of automation?

Dr Imafidon: It goes back to this point of where we offer things like the retraining. That is one that we actually are considerate about, in terms of working patterns and the unpaid work that women also end bearing the burden of doing, and ensuring we are able to provide training and the physical support for women to access that, whether it is things like childcare or any of the associated things that might get in the way of being able to retrain and re-skill.



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The other thing we need to work on culturally across some of these industries is that, where we are seeing that we need more people working and where we are seeing growth, we also need to do more to ensure that women are represented.

My personal example is across the technical industries, across STEM. In terms of those kinds of roles that are not going away and that are driving a lot of this innovation and this technology, we need to do more to ensure that those workplaces are places that women can thrive in, stay in and get to those managerial roles in as well.

Q186 Chair: What are the barriers to that?

Dr Imafidon: There are a number of barriers. There are some that are structural and cultural, where there is almost an assumption that women are not technical. When we look at recruitment and promotion processes, and even just at retention of women in those spaces, those things are not seen as a priority over some of the other things that those businesses are going for. That translates into various policies, such as babysitters for expenses, which we have as one of the examples from Caroline Criado-Perez's book, *Invisible Women*. I know there has been a crowdfunding campaign so all MPs get a free copy of that book, just in case you did not know. Tracy King has done a lot of work for you to be able to get that.

There are those kinds of examples. There is also looking at ensuring that we are also, as was mentioned by Vinous earlier, are looking at people who might not have had those technical backgrounds, and looking at how we recruit them into those. That often does become a barrier if you have not got an engineering, maths or physics degree. Very few people have those degrees anyway, and a tiny proportion of them are women.

How do we ensure that we are able to re-skill, re-train and have other routes for people that they are aware of, which they can then take up to join those industries? We also look at the qualities we value in managers in those industries as well, because a manager is one of those positions that, it is agreed across the research, is not going anywhere quickly

Q187 Chair: A different part of the labour market that is also at high risk is older workers. We have spoken a lot about what can be done through schools, FE and apprenticeships, but in terms of people who are older in the workforce, we are encouraging people with government policy in terms of the pension age and getting rid of the mandatory retirement age. People are expected to work for longer and most people will need to work for longer, because financially they will not be able to support themselves unless they do. What can be done to help older people stay in the workforce and adapt to the changes that we are likely to see in the years to come?

Professor Sir Christopher Pissarides: Older people are probably the group less threatened by automation, because if you think of automation as being mainly because of better data-processing by machines than



humans, then older people would not be the ones who process data; it is mainly younger people, women and various things. I am not too concerned about older people losing their jobs much more than the routine replacement of jobs in an industrial country by automation.

The problem remains in that many older people need to be relocated across the labour market at any one time, but I do not think automation will bring any worse problems than we are facing now. The way you do it there, for older people, is it really should be the companies' responsibility, so that they get the training there for the jobs that they do. Also, if you are near retirement and you are slowing down, older people have less objection to scaling down in the labour market gradually. At 65, they do not necessarily expect to be doing the same intensive job that they were doing at 55 and earning the same, which makes their employment easier.

Dr Susskind: At various points people have drawn a distinction between the burden of training falling on either the state or the employer. There are instances where it is also appropriate for it to fall on the individual and the worker as well. There is one example that is quite interesting in the US. There is a company called Lambda School; it is a nine-month computer science programme that is free, and you only start paying back tuition when you earn over \$50,000 at a rate of 17%. When you do that for a few years it is about \$30,000.

That is interesting because it is essentially allowing individuals who are re-skilling and re-training to borrow against their future income. We should explore innovations like that, whether it is provided, as in this case, by a private company, or a facility provided by Government or an employer. Exploring alternative ways of funding education as well is quite an interesting avenue to explore. Perhaps it is less relevant for older people but certainly it is something for those in the middle of their careers.

Dr Imafidon: Going back to the point on women, one positive piece of news is that the teaching and care professions, which have predominately female workers, are growth sectors against this backdrop of automation. There is an interesting trend that you see there, where anytime women do work it tends to be work that is undervalued and then is underpaid.

The other thing we will need to look out for is ensuring that we value the people that work within those sectors. We need to look at the pay that we currently have in those sectors and keep an eye on what happens to that as we are retraining more people to be able to join those growth sectors.

We also need to ensure that women can take on the managerial positions. If they have had more experience there, then we should not see what we see what we have in education at the moment, where the senior leadership tends to be male and then the people that are actually doing the work tend to be women. That is the other thing where, if we look at the education system, there is a lesson to be learnt there about



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who we value in that system, especially if we are going to take this seriously across adult and young people's education.

Chair: Education also has a very high gender pay gap, so there are big issues in the education sector as well.

Q188 **Vernon Coaker:** In many of our enquiries as a Committee, one of the things we worry about is the regional disparities and the differences within areas that you get. Just looking at automation, everybody seems to regard it as generally a good thing.

I was just fascinated by a map that we got as part of the evidence from the ONS, which was only published a week ago, about the probability of automation by region and area, with a low probability mapped out by ONS for England. If we regard it as a good thing, there are massive differences between the regions, and actually London and the south-east is one of the areas with the lowest probability of automation.

If you had asked me, I would have had it completely the other way round. Is this a good or bad thing? What should be done about it? If it is a good thing, how do we ensure that it spreads out everywhere evenly, so that we get equality of opportunity amongst people, regions, et cetera?

Professor Sir Christopher Pissarides: Automation is a good thing. The fact that it is concentrated is not a good thing.

Q189 **Vernon Coaker:** How do we spread it out?

Professor Sir Christopher Pissarides: How do we spread it out? We should spread it out on the job creation side, not by stopping automation in regions that have a higher probability on the ONS map, which I think I have seen as well. That would be like trying to stop progress in those regions that are usually the regions that are poorest across the country. That would not be good because you would be increasing the inequality between the regions.

The focus should be on the job creation side. On the job creation side, you are going to have the professional jobs; you are going to have the highly qualified research jobs, working with the machines. Those cannot be spread across the country whatever you do, because we have no other examples in other countries. Look at the United States: it is either California or Massachusetts that are doing those things; it is either Silicon Valley that is producing those or MIT in the Boston circle.

There will not be that many of those jobs. We have focused a lot of the discussion on those and how we train all those. They are the jobs that will drive the next phase of technological development, but they are not big in number, in terms of those that will employ all those people who are losing their jobs to automation. The jobs that will employ those people, as we mentioned before, are in hospitality and health and care, and those are the ones that should be spread across the country. Those should not be difficult to spread across the country.



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Q190 **Vernon Coaker:** That is really interesting. If I was talking from one of my estates where I am, they say that is exactly the problem: that the high-skilled, really well-paid jobs of the future will go to X and the rest will be left with the unskilled jobs that nobody else wants. If automation is a good thing, this a really big deal for social cohesion. Economically, that is the way the country will be driven, but there could be a social and economic cost of that to large numbers of communities, and many of us represent those sorts of areas. Is there no example of a country that has recognised that, and driven on to spread out that benefit much more widely?

Professor Sir Christopher Pissarides: It boils down to what Anne-Marie was saying before. It boils down to how much those jobs pay. If you make those respectable and well-paid jobs that are highly regarded in society, then no one will say, "We get the rubbish jobs and London and the south-east get the top jobs".

Q191 **Vernon Coaker:** I absolutely understand that. All I am talking about is what is reflected back. I am sure the Chair, in Leeds, Mark, in the West Midlands, and Peter, where he is, would agree. They missed out. Automation is great, but how is my area not going to be missed? That is a big deal and that is part of what we are looking at as well.

Professor Sir Christopher Pissarides: In my view, when you look at what you can do, you cannot avoid the fact that the Government have a role and inevitably there will be the transfers from the centres of that activity and from the top-end jobs to the other regions. Of course, we have always had those. As a student in the 1970s, we were talking about regional transfers and why they were not making more of a difference than they did. It is a difficult issue.

You asked about countries that did better with the regional inequalities. Sweden is a good example. It is a much smaller country, of course. Germany is a good example, but maybe Germany is by coincidence rather than design, because it does not have a London or a Paris where most activity takes place. They are scattered much more across the country.

Vernon Coaker: It is really interesting.

Dr Imafidon: Given that we have London and we are not going to change that anytime soon, the other interesting examples that we see are where we go wider than automation and look at other technical roles. There are innovation hubs. TechUK has done a lot of work on this to ensure that you have local hubs of innovation, with innovation centres.

Around universities as well, we tend to have these high-tech innovations, enabling those companies, start-ups and spin-outs to stay where they are, whether it be in Bristol, Sunderland, up north and even across Scotland. That might be the other thing that you want to look at doing. I know Sue Black and techmums have just got a big fund to be able to retrain mums up in the north-east.



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There is a lot to be investigated there in allowing areas to find out what they can be innovative in and looking at what you can build up around those centres. Revitalising that area in that way becomes the first roll on the rolling ball. Innovation will come, but we all learnt to code or we all learnt to run social media or whatever it might be. We need to empower other parts of the country to be able to do that.

When we talk about technology and those more highly skilled roles, if we want to distribute those evenly, technology has allowed us to be able to do that. On the internet, no one knows whether you are a dog but also there is the flexibility we now have where you can work at distance. Maybe the Government will want to incentivise that distributed kind of working.

WordPress is one example. WordPress does not have offices. The company does not have offices. People work wherever they are and they all dial in. Are we going to be able to do that? That then goes back to ensuring the right infrastructure across the country to be able to do that. Again, we have been to-ing and fro-ing on that for ages.

Q192 Peter Kyle: Do you think that the Government are taking the changes in the workplace seriously enough in automation?

Dr Susskind: For me, as I said right at the start, my thought is that in the medium term the most important challenge is not a world where there is not enough work but it is making sure that people have the right skills and capabilities to do the work that is available. I used the distinction that either we teach people to compete with machines or we teach them to build machines. Sometimes that can sound relatively anodyne or oversimplified, but when you look at what we are actually doing on each of those two relatively simple categories, we are not doing enough.

On “build”, for instance, the Royal Society did a report in 2017 reviewing computer science education in the UK. They surveyed a number of teachers and they found a large number of them did not feel confident teaching the material and many had no background in computer science. There was probably a sense in the policy world that information communication technology, which was the previous course, and computer science both had something to do with technology so we could just ask the same people to teach a different course. That has not worked. We are not doing enough there.

If you take “compete”, the OECD did a study in 2017 looking at adult skills around the world. They were looking at PIAAC skills, so literacy, numeracy and problem-solving, and what they found was no examples of education systems that prepared the vast majority of adults to perform better in those three skill areas than the level that computers are close to reproducing.



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The answer is that I do not think the Government are taking that seriously enough.

Q193 **Peter Kyle:** Would the other two agree broadly agree with the thrust of that?

Professor Sir Christopher Pissarides: I agree entirely. To find out whether the Government are doing enough or not, you should be looking at the outcomes, at what is coming out of the labour market because of automation, and there is not really enough coming out of Britain, if you compare Britain with comparable economies.

Q194 **Peter Kyle:** Do you think that the Taylor review was comprehensive enough?

Professor Sir Christopher Pissarides: It was a very good review and it was a good start. Obviously, there are so many other things you can talk about, but it was definitely a positive thing.

Q195 **Peter Kyle:** In terms of the long term, is the thinking coming out of Government long term enough, bearing in mind that to prepare skills for the future labour market you are talking about a 20-year lead-in? You are shaking your head

Professor Sir Christopher Pissarides: Is anything very long term now?

Dr Imafidon: Nothing has been long-term for a while, right? I do not think we are. To Daniel's point, it was like asking French teachers to teach Latin because they are vaguely related. That was what ended up happening. It was a bit of a shoddy bridge-gap that did not really take into account the importance of these skills and the knowledge and knowledge transfer.

There is lot more across the education system that needs to be revamped and I do not think the Government are investing enough into the education system. In real terms we have seen less money being spent on education, which at this point, if this is something that we seriously know is coming up, we need to act now as much as we can.

Peter Kyle: It is interesting. I use the example of Sure Start. Sure Start was created in 2000. The first young people who experienced Sure Start have only entered the labour market this year, providing they have not gone into higher education. It does show just how important that is.

Chair: Thank you. The evidence this morning has been really fascinating, so thank you very much for your time.