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(bright music)

Alex Miller - Host
00:00:07,560

Hi. I'm Alex Miller. And this is the Citi Institute Podcast, where we explore the forces shaping finance, the global economy, and the way we all live and work.

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In each episode, we bring you insights from thought leaders and innovators driving change, helping you stay informed, navigate challenges, and seize opportunities in a rapidly evolving world.

Arvind Purushotham
00:00:28,500

These disruptive technologies and the timeframes associated with them - the word disruptive sometimes implies it happens, you know, in a jiffy, right? It, it, these things don't happen immediately.

Professor Carl-Benedikt Frey

00:00:41,940

Innovation clusters will continue to matter. And so exploration is always serendipitous

Alex Miller - Host

00:00:50,850

Today, we're going to be exploring the profound impact of technology and innovation on our societies, economies, and institutions.

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We're going to dive together into the transformative power of AI and frontier technologies, the implications, financial services and the future workforce, and the critical role of startups in driving disruptive change.

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I'm delighted that we have Professor Carl Frey, Associate Professor of AI and Work, an Oxford Martin Citi Fellow, and a leading voice on the interplay of innovation, technology, and the conditions for progress, and Arvind Purushotham, Head of Citi Ventures, Citi's venture capital investing arm.

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I can't think of two more compelling guests for this topic. So without further delay, let's jump in.

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Carl, I'm going to come straight to you. You've been writing about technology and innovation for, frankly, the better parts of a decade, right from your work around your recent work, but particularly your just published book, **How Progress Ends**, which obviously delves into the fundamental tension between exploration and exploitation innovation.

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Can you just sort of zoom out and, I guess, set the scene for us, describing how, in your view, societies historically have navigated this balance and what the conditions are required for each type of innovation to truly flourish?

Professor Carl-Benedikt Frey
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Yeah. First of all thank you very much for having me. It's a real pleasure to be with you.

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So a key point I'm trying to make in my book is that technological progress entails two very different tasks. So one is exploration, actually conceiving something, coming up with a new idea or product, and then actually executing upon that activity.

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And so certain institutions are better suited for doing the latter, and certain institutions are better suited for doing the former.

Alex Miller - Host
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If I understand correctly from what your book was arguing, Carl, you're arguing that at different points of history, you can look at different societies and argue that they were perhaps in an exploration phase, but perhaps began to stagnate as they moved into an exploitation phase. Is that correct?

Professor Carl-Benedikt Frey
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Well, you can certainly see that some places that were very inventive didn't do as well in terms of implementing the technology and scaling up. And so Britain is such an example. It pioneered the First Industrial Revolution. It did relatively well in the world of small scale industry. But many of the inventions that would empower the Second Industrial Revolution, Britain was at the frontier in electrical industries, for example, but really failed to build electrical companies on similar scale to Germany and the United States.

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Same is true in railroads. Britain pioneered the railroads, but ended up building a fragmented network with ineffective, inefficient management which consumed, just those inefficiencies, around 1% of GDP, whereas the German system were much better planned from the outset and so, yes, there are examples where you can lead the way in a technology, but then fail to harness it to its full extent.

Alex Miller - Host
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Arvind, we heard there from Carl talking about the importance of investing and investors over time. Perhaps you could introduce your role here at Citigroup, your own investing background, and I guess how that intersects with the innovation that Carl's been describing there.

Arvind Purushotham
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I've been an investor for about 24 years in the venture capital space. And currently, I lead Citi Ventures, which is one of Citi's main strategic investing groups. I think Citi's leaders recognize sort of the oncoming FinTech revolution way back. And so we were set up 15 years ago to exactly exploit that, right?

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Which is the intersection of startups and technologies and everything that's been happening in the decentralized world, external to the large companies and see how we could, you know, benefit our clients and customers and stakeholders by bringing the best of those in.

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What we try to do is not just invest, but then really explore a partnership with these companies so that there's a win-win that occurs between the startups that we invest in and Citi and Citi's clients and customers and that's what we do. And if we just think about sort of the approach that we take in the context of this particular topic, one of our jobs, frankly, is to be looking on the outside for these kinds of disruptive technologies and technological trends, and to understand the implications of those trends for financial services and for Citi, in particular. And then when we identify such trends, then we're able to bring those in, not just in the form of thought leadership. We do a lot of that.

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We write articles, we bring sort of our market strategic insights to our business leaders. But also actual capabilities in the form of startups that are building innovative technologies or innovative products and that's sort of the nature of what we do.

Alex Miller - Host

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And maybe you could just sort of touch briefly on there, Arvind, some of the characteristics you look for when you're looking for a startup that perhaps gives you signals in terms of its potential to succeed. Because we've heard from Carl around that sort of the top down. But you're, in a sense, looking bottoms up, aren't you?

Arvind Purushotham
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In the early stage, you know, what you're looking for are people or teams with big ambitions, teams with a lot of credibility and experience, A+ teams, so to speak, who can, who can build a great team.

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And then you're looking at the general area and saying, "Well, is there existence proof of success?" Sometimes the interesting thing about what we do is you invest in areas where there is no existence proof of success. And I can say, think of several there. And that's part of the challenge of, like, investing in disruptive and new technologies.
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You can think of SpaceX going back 20 plus years and saying, "Okay. There's not a lot of you know, existence proof of success in the startup world, building space startups. But nonetheless, SpaceX got funded based on the strength of the idea, the team, and so on and so forth."

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But ambition and the area, the size of the opportunity and then in our case, certainly, the relevance to financial services and to Citi, right? And that's an additional filter that we apply when we invest in these companies. When you go later on, I think that we look for proof of adoption, proof that the product works, proof that, you know, there is a viable business model, proof that it brings value to its customers.

Alex Miller - Host

00:07:31,920

Carl, if I bring it back to you, so, you know, we've heard there about how to identify success. One of the great success stories clearly of today's era is, of course, Artificial Intelligence. You've written extensively over the years, not just recently, around that sort of so-called productivity paradox.

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Can you just kind of share beginnings of your thoughts around how we should think about AI in that kind of grand sweep of innovation?

Professor Carl-Benedikt Frey
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So if you look over the course of history sustained upsurges in economic growth and productivity, in particular, have come during periods when we see new industries, new types of activities emerging.

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And the key reason that we saw very rapid growth in the post-war period was that automobiles spawned the largest manufacturing industry the world had ever seen, that it spawned a host of industries producing components that are going to making those cars, that it produced a host of industries producing the machine tools needed to make the components.

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And in addition to that, you have road commerce emerging, mass tourists. And you have a host of electrical industries that create a wide range of new jobs and activities as well.

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We have not seen anything similar to that so far with either computer revolution or Artificial Intelligence.

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They've given us access to the world store knowledge in our pockets.

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They streamlined the research and discovery process enormously. They connected the best scientists and inventors around the world.

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And what do we get? A decade-streak productivity upsurge mainly confined to the United States. Decline in research productivity. Takes 18 times as many scientists to produce Moore's law today than it did in the 1970s.

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And we see a decline in breakthrough innovation and so something must be wrong because these technologies should be driving growth to unprecedented levels.

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And I think it probably has to do something with how it interacts with our institutions. So if you get the productivity tool, you can do one or two things. You can do more or you can use the time to dig deeper.

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You can drill more holes or you can dig deeper. And what we see is that when people do more projects, inventors, when inventors do more projects at the same time well, their attention is spread more thinly. And so they're more, less likely to actually make a breakthrough discovery.

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And so in academia, it's publish or perish. And that's the structure we face. And I think that has really been shaped people incentives and meant that we used computer technology to do more things rather than digging deeper.
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And I worry that, you know, we will see the same thing with artificial intelligence, which is also a tremendously promising productivity tool.

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And then on top of that, we layered a range of rules and regulations that make, you know, discovery very expensive.

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And I'm not just talking about the AI Act. So, one of the most promising applications for AI, I think, is in medical discovery. But, you know, even if you see AI having a material impact there, you still need to go through clinical trials, which means that you probably need to partner with a large pharmaceutical company in order to do that.

Alex Miller - Host

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Maybe, Arvind, you could talk a little bit about how you're thinking about, I guess, broader AI architecture, the kind of, you know, the bringing in of probabilistic reasoning from LLMs and I guess how this evolves within financial services. Presumably some of the companies you're looking at have, you know, AI at the heart of what they're doing.

Arvind Purushotham

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These disruptive technologies and the timeframes associated with them. The word disruptive sometimes implies it happens, you know, in a jiffy, right?

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It, it, these things don't happen immediately. Just because something is disruptive, that can happen over five years, 10 years, or 20 years.

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And you can look back at sort of the first internet wave in the late '90s. And now we're 25 years on. And you see the how our world has changed because of that because of the first internet revolution. Of course, all the fibre and the communications infrastructure that was laid out and so on and so forth.

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You can pick up on cloud, for example, which is about 15 years old, and how that has changed everything that we do from a technology perspective.

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So, when we think about sort of what's happening in AI, I think it'll have a similar timescale. It is disruptive. It can reshape industries. It can reshape, in fact, what a company is.

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And, and we should talk about that, but it's going to take some time. And, one of the components around adoption of that is trustI think of two broad things when we think about trust when it comes to AI, particularly for financial services.

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One is just the safety aspect of it around privacy, around safety and, and sort of having the right guardrails. And that, you know, that's becoming a solved problem, right? We were, in fact, investors in an early company. And they were providing, and they provide prompt security.

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And so you need technology components like that for people to be able to trust it and for enterprizes to be able to roll this out. And second and which is a little bit more fundamental aspect of trust is, you know, does it work as advertised?

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Is it giving me answers that I expect? Is it hallucinating and so on? And so, one of the most fascinating things, in my 25-year journey, one of the most fascinating aspects of AI and what we're seeing now is the pace of change.

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We have never seen this pace of change in any other previous technology in the last, you know, 30, 40 years. And, and what does that mean? It means that there are very powerful tools that are being developed. Some of those tools are new around foundation models and all the rest. Some of them are old.

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And so you look at sort of the adoption of, you know, ChatGPT or you look at the adoption of any of these tools it's exponential, right? The numbers speak for themselves. Now, the question is, is it sustainable? Is it, you know, a indicative of a secular trend? Or is it going to die down after a little while? Time will tell. But, you know, I think that the venture industry and venture capitalists are betting that it's here to stay, that, you know, it may take five or 10 years for full adoption, but it's going to happen.

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It's a matter of when, not if.

Alex Miller - Host

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I guess one of the questions I'd put to you, Carl, is, you know, you mentioned in your book, you know, a whole host of examples around how technological revolutions, you know, often widen inequality before they perhaps shrink it in that longer term, and the role of incumbents, you know, within that when you think about what we're seeing within that AI, you know, revolution, how do you think about labor markets, the roles that institutions have in perhaps mitigating or, indeed, inadvertently exacerbating some of these effects?

Professor Carl-Benedikt Frey

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I think it's natural to some degree that when a new technology arrives, you tend to think, "How can I use it to do what I currently do more effectively?" It then tends to tilt you towards automation and process improvements.

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But the real question, which tends to deliver more spectacular results is, what is it that I previously couldn't do that I can now do with the help of this tool?

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And that's when you tend to develop new products, new sectors of the economy, to which labor can reallocate. And that's where most growth tends to happen.

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And that's also one of the reasons why we often, during the initial automation phase, get widened inequality, pressure on wagers, often societal resistance.

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And then when we come out of that, we see these new sectors emerging. It's more smooth sailing and the pie is growing. But that initial phase can be a long time.

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So I think there is always resistance to new technologies. And that's always been the case and the Industrial Revolution is no different in that regard.

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And institutions played a role there too because Britain, unlike other economies, had the poor Lords…They had taxed themself at 2% of GDP to provide for the poor. And in places where the poor Lords were more generous, you saw less resistance towards mechanization.

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And I suspect within organizations that are better able to manage these transitions, you will see less labor unrest as well. So we saw, for example, back in 2018, 2019, unrest in Los Angeles at the harbor as autonomous cargo trucks were introduced and workers protesting.

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The same trucks are being used in Norway and in Amsterdam. And we didn't see any reports of protest there. And so most likely, labor market institutions in Norway and in the Netherlands were better capable of dealing with that kind of disruption.

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Now, I don't think that most disruption, when it comes to AI, is going to come from outright automation. We will see, you know, some tasks being taken over by Artificial Intelligence completely.

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But for the most part, what AI in its current form does is reducing barriers to entry in knowledge work and professional services. So it's a bit like, you know, GPS technology and tax and services with you know, with GPS technology knowing the name of every street in London was no longer a particularly valuable skill.

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And then, you know, with the Uber app matching supply and demand, anybody could get into, get into their car and top up their incomes on the side. And that was good for a lot of people but it was bad for incumbent taxi drivers who essentially took a pay cut from that competition.

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The difference with knowledge work, of course, is that it's tradable. It can be done anywhere in the world. And so if you look across space you'll see that an accountant in Frankfurt earns roughly an order of magnitude more than an accountant in Cairo, or a software engineer in London or earns an order of magnitude more than a software engineer in Manila.

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And if you didn't think of AI as reducing the productivity differential between these workers, what you will likely see is more hiring in places like Cairo and Manila and less hiring in places like London.

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And we're already going to see, we're already seeing some anecdotal examples of this with law firms cutting headcount in London, increasing headcount in Poland and India.

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And so I think we will see more of this labor arbitrage that will put pressure on wages in high income places, but it will also reduce global inequality by accelerating service exports from emerging economies.

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So it's a mixed picture, but I think, you know, for middle income countries, it's clearly a good trend, but it might be bad news for many.

Alex Miller - Host

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Arvind, you mentioned earlier the notion of kind of the future of the company or how companies might change. And I know there's a view out there that, you know, a positive view from an AI perspective that, in a sense, we're moving into a golden age of startups.

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It's easier to start companies. You know, you don't need quite the same sort. How do you think about AI within that context? And then perhaps, let's just sort of start with that perhaps.

Arvind Purushotham

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All these new technologies do reduce barriers to entry. When I first started in venture capital 25 years ago, you needed about $5 million to build a software company.

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And then it started with, like, buying servers, buying space in a data center, plugging them in, and then writing software, and then launching it. And now, we're four orders of magnitude down (laughs) to launch a piece of software, right? You can literally do it with a credit card from a laptop sitting in a cafe.

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One of the interesting ideas, and I just, you know, heard this from Satya Nadella recently in a podcast, is what, you know, does the nature of the company change?

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What does a company mean? What does a business mean in the coming years? And so, for example, you can take a company that is a payments company, for example. And can you encapsulate everything that the company does in a model?

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So does the company become the model? All the institutional knowledge, all the physical knowledge, everything that the company has built gets encapsulated in the model, and then the model becomes the company.

Alex Miller - Host

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It's fascinating. And I guess that sort of speaks to that connectiveness also with where you get innovation often in its earlier stages coming out of universities, academia, what, Carl, I think you call innovation clusters and their importance over, well, many, many centuries.

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You mentioned there that sort of relative perhaps barbell of emerging markets perhaps taking greater importance. Do you see that sort of enabling distributed work and sort of global talent pools?

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Or, or do you think actually you get a doubling down on these innovation clusters particularly in advanced economies, Carl?

Professor Carl-Benedikt Frey

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I think innovation clusters will continue to matter. And so exploration is always serendipitous. And if you look at the places that are the frontier of innovation in digital technology, in particular, they are highly clustered and continue to be. And I think that's one of the domains where AI is most unlikely also to replace humans, is at the very frontier, right?

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The way that we learn is through trial and error, through experience, to experimentation. We don't come pre-trained in the way that AI does.

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And so for that reason, I think innovation, human innovation and creativity will continue to matter. And I think actually AI will make human contact or in-person communication more valuable because how do you distinguish yourself in a world where AI writes all your emails and do most of the interaction in the virtual space?

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Well, it's going to be through in-person communication and human connectivity. And I think that means that these clusters will, if anything, gain in importance.

Alex Miller - Host

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It reminds me of that great quote. I, I think this attributed to, to Einstein when he was asked, "What's the most important thing you've learned?"

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He said, "It's not knowledge. It's the importance of imagination." And that seems to be very much what you're arguing there.

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Arvind, you know, when you think about Citi Ventures and venture capital generally trying to invest, you know, there's a whole realm of different technologies you could be looking at.

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I know quantum is one area that you're interested in, but obviously there's the world of payments, one quite mature, one quite nascent.

Arvind Purushotham

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Yeah. Quantum is sort of in a relatively nascent stage still. And, and one of the things that we do is try to monitor these spaces for relevance to Citi and for financial services

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but obviously, it's a very powerful technology once it is viable in, in sort of real world use cases and, you know, one of the things that Quantum is very good at is optimization problems and the speed at which it can handle optimization problems.

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The other, of course, is, is cryptography and what it can do to you know, encryption and existing encryption schemes. So with any of these technologies, you think about sort of the, you know, sort of the offense and the defense, right?

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The offense use cases and the defense use cases and so we're exploring both.

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One of the things that we talk about a lot internally with our business leaders is, sort of friction to getting things done and the reduction of friction and what's the best way to do it.

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When you truly have a frictionless experience, it's actually can be quite magical. I still remember the very first time I took an Uber that may... I think it was in 2011. And I just walked out of the car and didn't have to do anything because the payment was embedded in sort of the whole experience.

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And so you take that and multiply that a thousand times in all kinds of business to business settings, business to consumer settings, consumer to consumer or P2P settings.

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And one of the ways in which AI can help is actually to continue to reduce friction because it can handle, you know, fraud more, more automatically.

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It can handle identity more automatically. It can handle exception cases, exception handling more automatically. And so we think about payments. And sort of the broad idea is, let's embed payments where they're necessary.

Let's make them frictionless. Let's provide those magical experiences to clients and customers. And how can AI help us do that?

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And that's sort of the approach we take when we think about investments in those areas.

Alex Miller - Host

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That's one thing, you know, Carl, I know you've been, you know, thinking a lot about, is when you think about national competitiveness, every government, you know, obviously argues it will be one of the leaders in this case in the AI, but it could be a different technology.

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What are those characteristics that are suggestive to you through time that you're going to have the required institutional adaptiveness that allows the exploration phase to flourish, and indeed to recognize when you're moving from exploration to exploitation?

Professor Carl-Benedikt Frey

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If you look at the United States, for example, the Federal Systems meant that you can have certain variation in rules and regulation on the state level, for example.

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And so in the state of California, non-compete clauses are wide. And that meant that when a number of engineers left Shockley Semiconductor to set up Fairchild, they could do that.

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And two of those then left Fairchild to set up Intel. They could do that. Those were pivotal moments in Silicon Valley's history and for the renewal of the cluster. We saw the opposite happening in Michigan where Detroit was once the Silicon Valley of the United States. And as non-competes became enforceable, you see dynamis declining in response.

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And so in the United States, you have these pockets where you can experiment, and then you have a large internal market, which are basically barrier free in terms of trade, where you can scale up quickly.

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In Europe, we have the opposite in a way. We have, you know, a lot of EU-wide regulation, which to some degree reduces the capacity for experimentation.

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And then we have a lot of national exceptions piled on top of that which means that you can't really scale up either (laughs), and so you have this situation where the IMF estimates that if you take all trade barriers and services in the European Union and you add them up, they amount to roughly 110% tariff.

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And that obviously caps the return to investing in innovation in Europe at the same time as it constrains the possibilities for exploration. And so we need to reverse that.

Alex Miller - Host

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When you're thinking about obviously some of the accelerating pace of change in different technologies we've been talking about, how do you think about that balance you need to strike from your investing perspective in terms of supporting incremental innovations in mature areas, you know, greater productivity versus slightly sort of, you know, paradigm shifting, paradigm changing technologies?

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Because presumably you have to kind of strike a balance there.

Arvind Purushotham

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If you go back five to seven years, we started to see more and more venture capital firms that wanted to invest in deep tech. People said, "Hey, there are lots of companies investing in apps and in software and data and then, you know, consumer internet and whatnot.

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How about deep tech?" And there's an opportunity there. So we've started to see a lot more investment going into deep tech, a lot more investment going, frankly, into hardware and hardware/software, you know combined systems and so on, and so on and so forth.

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So we specifically look at sort of a very, you know, financial services you know, oriented lens, a Citi-oriented lens from that standpoint.

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But I think the good news is that the capital is out there just because of the breadth of the venture ecosystem, the availability of capital that, you know, all of these different pockets can get funded, all these different pockets have enough capital to thrive and to go from there.

Alex Miller - Host

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If you look for that forward sort of five to 10-year sort of horizon scanning perspective, what are you most interested or intrigued by?

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Is it the power of Agentic? Is it something else? Is it Quantum? B- with regards to kind of the future of finance, in particular.

Arvind Purushotham

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If I look at the five to 10 years, it's still going to be the world of AI and AI adoption as it happens throughout different industries and the power of agents.

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I spoke about how powerful these tools have gotten. And so, you know, we all experience that. It's all available for free, you know, on the internet, or on your mobile phones.

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And so what does that mean in terms of, you know, financial services? And if you look at financial services that intersection of AI and financial services is extremely rich. All the way from the front end to the backend and everything in between can be impacted in a very positive way by AI.

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Citi has publicly announced Citi Assistant, Citi Stylus and tools like that that are, that have been rolled out to 100,000 plus employees globally.

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Those are horizontal tools. And that makes us, you know, each one of us more productive. But when you look at some of the vertical use cases, some of the most impactful ones could turn out to be some of the vertical use cases.

Alex Miller - Host

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Carl, maybe just as we come to a close, you could just sort of, again, zoom out a little bit and remind us kind of what your kind of core message is when thinking about innovation over time and how we should apply that lens to thinking about what's happening around the world today.

Professor Carl-Benedikt Frey

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So I think an important thing to realize is progress is not automatic, right? It is something that is always work in progress because the existing structure, existing institutions tend to favor incumbents.

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And we have a tendency in Europe to do that through regulations like the GDPR as well, which by any estimate has been particularly bad for startups and which by any estimate… technology firms which have essentially managed to offset compliance costs by capturing a larger share of the market.

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And so I think the importance of dynamis for progress is really important to bear in mind. And right now, we've seen that mainly in two places, the US and China.

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But even in those two places, dynamis is in decline since the 2000s. And so I'm very excited about the prospects of AI and what you can do with this technology.

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But it's important to also bear in mind that if we want to unlock the potential for that technology to really accelerate economic growth, we also need institutional change.

Alex Miller - Host

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That's fascinating. And there's a powerful message.

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A big thank you from our listeners to you both for a really magisterial sweep through this topic. And I'm sure we'll look to come, come back to you again in future.

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Carl, Arvind, thank you.

Professor Carl-Benedikt Frey

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Thanks, Alex.

Arvind Purushotham

Thank you, Alex.

Alex Miller - Host

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So we really unpacked a lot in that conversation. Carl talking to us about the notion of innovation over the centuries through different societies. The importance of a consideration of exploration versus exploitation and what the kind of preconditions of, for success are.

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We heard from Arvind around the notion that innovation isn't guaranteed nor is it instantaneous. These things can take time. And that's why the long view is important as well and perhaps also this notion that whilst knowledge is important, imagination, as Einstein said, is perhaps even more important.

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And for AI to unlock some of the capabilities that it offers it can't simply be about process improvement. It has to enable things that haven't even been previously conceived.

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A lot to unpack, but fascinating.
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And if you'd like to know more, Carl's got a fantastic book out, **When Progress Fails**. Highly recommend it. Had a really good read of it myself

00:32:58,020

and also look out for the Citi Institute latest in their series on disruptive innovations where both Carl and Arvind will be writing.

00:33:27,849 --> 00:33:34,000
(bright music)