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The US-China Tech Race

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Allison Nathan: The world's two largest economies are competing in a tech race that some have compared to the Cold War nuclear and space race between the US and the Soviet Union. So is the US or China currently ahead? And what will determine who ultimately takes the lead in this technological rivalry? I'm Allison Nathan, and this is Goldman Sachs Exchanges.

Each month, I speak with investors, policymakers, and academics about the most pressing market-moving issues for our Top of Mind report from Goldman Sachs Research. I recently spoke with Mark Kennedy, founding director of the Wahba Initiative for Strategic Competition at NYU's Development Research Institute, and with Paul Triolo,

partner at DGA Albright Stonebridge Group. I started by asking Mark just how important a role tech plays in the US-China strategic rivalry, and who's winning the tech race today.

Technology certainly seems to be at the center of the US-China strategic rivalry. Is that an accurate characterization of the role of technology within this rivalry, or do you think that there's just too much emphasis on that role and that it's being overplayed?

Mark Kennedy: I don't think it's being overplayed. Tech isn't just at the center; it's really the switchboard because whoever's going to route the data, the standards, the compute, in the future is really going to impact every domain from military might to economic influence to how you reach out with your message. And I think it's not overplayed, but I think what's underplayed is the geopolitical implications of that.

When we think about the tech race, we need to understand that there's really four arenas in this tech race. Who leads in the technology? Who leads in applying that technology? Who leads in installing the digital plumbing that really

underpins everything? And who leads in terms of self-sufficiency?

On most of the leading technologies, US is winning, on semiconductors, on AI frameworks, on cloud infrastructure, on quantum computing, on global talent. But there's parts of the technology where China is winning. They're ahead on quantum communications and hypersonics, on batteries. In terms of applications, China's really pressing hard and catching up in many areas and ahead in some. When you look at, like, robotics, one measure shows China using 12 times as many robotics in their manufacturing when you adjust for the income scale differences of employees. So they're leaning hard into trying to keep their manufacturing edge by staying ahead on applying robotics.

And in global installations outside of our closest allies, China's dominating. If you look at Huawei, they're as big as their next two largest competitors. They're dominant in the Global South. And when it comes to independence, China is deliberately, through their dual circulation and other strategies, focusing on achieving independence and you're seeing that with the recent edicts of the government of not

allowing some of their companies to buy Western chips. They're giving energy discount if you're training your model without using Western chips. Just one of a thousand different ways that they've been trying to gain independence and encouraging that.

The US will be dependent on China for some time to come. So I'd say America's largely ahead on the first aspect, but China is either catching up or ahead on the other aspects of this tech race.

Allison Nathan: So we think about where each country has leverage and how it's exercising that leverage. How much have the export controls the US has implemented impacted China's technological advancement?

Mark Kennedy: Well, first of all, China was planning on not having to be dependent on American chips to begin with. The tech restrictions have accelerated their push in that direction. They're finding ways to be able to do with less advanced chips and do have access to US chip technology at some level. So it's slowing them up, but this will not be the silver bullet that will keep the US in the tech lead for an extended period of time.

Allison Nathan: And if we think about the leverage China has -- and we've heard so much about rare earth minerals -- will its grip on these rare earths impede the US's ability to maintain its leadership?

Mark Kennedy: It's critical, and they've given us a one-year -- if it lasts that long -- reprieve from the more restrictive controls on rare earths. The US needs to take that seriously, but we've known about this for a while and we've admired the problem as opposed to really taken deliberate steps. There have been some more recent steps of taking ownership interest in rare earths investing, but here we need our allies. So Australia, Canada, others are vital to those sources of supply. So I think we need to be even more deliberate than we are and take the risk of China's chokehold on this very seriously.

Allison Nathan: So what else does the US have to do to win the tech race?

Mark Kennedy: You need to have the best technology. We're either flat or reducing our funding for research at universities. We're making it harder for the world's best

talent to come in. We need to have the scale to match the deliberate effort that China is putting in to own the wiring, own the rails, own the digital flows in the Global South or we're going to sacrifice them.

Are we going to live up to the standards that'll make sure that the tech we advance is meeting the values and standards that we've always held? There's some question on the former, and there's an increasing question on reliability. Without having the same standards that many people are looking for, that's going to mitigate our trust.

The other thing that's very much mitigating our trust is things like cutting off satellite access for Ukraine even for a day. Or the AI rule that says that we may decide not to sell to you. So with China, countries may not trust the installation once it comes in there, but China is selling the: "We're a more reliable supplier to you than America."

And energy is going to be very important. Can we scale up our energy at the level that we need to power the data center growth that's going to be necessary to have the compute power to win at that level of the best technology? If you look at what China is doing in the renewable

energies in terms of wind and solar and nuclear and others, they're leaning very heavily into that. America, as you know, is start, stop, go, pause, and we have a lot of natural energy from traditional sources, but China is working very hard to make sure they have the sources.

We are leaning now more heavily in the nuclear, and we need to. But there's it's going to take a while to achieve that.

Allison Nathan: The US government does seem to be taking a more active role in important sectors to make progress toward these goals. We've seen, for example, reports that the government is funding or partnering with companies in the rare earths space. So will those kinds of policies move the needle at all?

Mark Kennedy: Well, the access to the minerals that they will allow us will help, but it's something we are going to need to do because these are very volatile, cyclical commodity markets. And China, with their dominance, has the ability to basically bring the price down, squeeze out competitors. So it's unrealistic for us to have assured supplies of some of the most vital minerals if we're not

willing to have some kind of an offtake agreement where we're guaranteeing a level of price that they can at least sustain their production. Those are going to be necessary to have the sources of supply at the mineral level that will allow us to do the magic at the digital level.

But it's unclear how, for example, taking an ownership interest in Intel is going to be long-term beneficial, or could that be negative to the extent that either a real or a perceived golden share prevents some of the tough actions for restructuring that are going to be necessary for Intel to become globally competitive again? There's absolutely no question that having our own foundry is vital. And right now, at scale, the only player we have is Intel.

We have TSMC investing in us, but their primary interest is Taiwan and keeping that silicon shield. And what they're doing in America is a shadow of what they're continuing to do and building on in Taiwan. So the interest is there, but it's hard to point to examples of the US investing in commercial enterprises -- particularly mature commercial enterprises -- that have had a long-term beneficial impact.

Allison Nathan: Let's go back to China. We talked about

the US. What further steps must China take to win the tech race?

Mark Kennedy: First of all, they're doing a lot of things right. Most effective is that they are sustained, deliberate, stay on course, target their efforts. You know, when you look at the research that they're investing into these technologies and compared to the US, US is still somewhat ahead on total research but China is all directed at a few key technologies that they think are going to determine the future. And so I think having a sustained level of investment has been very helpful to them.

They are also focused on sources and markets. They didn't just think about rare earths yesterday or last year or last decade. They've been thinking about it for a long time. But it's not just rare earths. If you look at ports, if you look at many other areas, they know what they need to have continuing to come into them, and they also know that they need to have markets. They're doing a much better job of establishing markets in the Global South and other places to have. And they're willing to take sacrifices to achieve that. They need to make sure they have the Global South locked up as a customer base because they

see US and Europe and other Western allies moving away from them.

But they also see that they need to very quickly develop their chip industry. So part of what you're seeing is them favoring the local chip manufacturing and industry so that commercial dollars are flowing their way. It might still be Chinese commercial dollars, but to fund that development and to accelerate that development. And are willing to sacrifice some near-term performance in order to achieve that.

The other thing they need to do is they need to be trusted because the Chinese model is controlled. And not only do they come in with control, it's not interoperable, it's not easily changeable, you're kind of locked in, but they also have the China cyber laws that would require any Chinese company to give the government any data that it asks for. So those types of things reduce trust.

This is in many ways a battle for trust. America can win that battle if we focus on it. China's further behind in that, and that's an area where they need to make sure that people not only think their tech is cheap and reasonably

good but is trusted.

Allison Nathan: So who's going to win this tech race? The US or China?

Mark Kennedy: I don't think we can say, but again I talked about the four pieces of it. I can see a world where America wins the best technology. But China has the most installations. You know, when you look at the number of electronic engineering graduates and PhD they graduate every year compared to us, they're dramatically more than us. And that quantity takes on a quality of its own, so I can see them winning that application track.

I can see them winning the installation track, particularly outside of America and its closest allies. And I can see them winning the "we're independent of you but you're still dependent on us" race. So you could have a situation where we're owning the blueprints, but they're owning the buildings.

We're in the lead in the code, but they're in the lead in the circuits. And that has huge geopolitical and economic consequences for America.

Allison Nathan: Paul Triolo, partner at DGA Albright Stonebridge Group, agrees that the jury is still out on whether the US can maintain its tech lead and specifically its lead in building the world's most powerful AI models. He says much will depend on whether China can overcome critical chokepoints in the semiconductor supply chain.

When we think about the global semiconductor supply chain, it is at the heart of this AI technology, where are the chokepoints? And who controls them?

Paul Triolo: Great question. So I think, first of all, there isn't one supply chain, right? There are multiple, interlocking global supply chains and products back and forth across continents. There are maps that show the wafer starts here, it goes here, some value added here, it goes here, then it's finally packaged, then it goes into a product. So the word "supply chain" is not all that representative of what the reality of the industry is. It's the most complicated set of technologies that crisscross the globe to get put into a final product.

There are these key technologies that are part of that. So

the first one that is fairly commonly talked about is advanced lithography. This is the tool that eventually prints the picture of the semiconductor layout onto a silicon wafer. And that's being done now at levels it's really hard for the human brain to comprehend. Two nanometers, right? Which is way smaller than a single strand of hair. So the dimensions of these semiconductors, the dimensions which we're talking about for the features -- these are the feature sizes -- are really, really teeny and have been shrinking rapidly over the last 30 or 40 years. This is what's been driving Moore's Law, the doubling of capacity and capability every two years.

And so lithography has ended up being this key gating function, if you will, because ASML, this Dutch company, ended up developing the most advanced lithography, extreme ultraviolet lithography tools over the course of the last 20 years, moving through successive types of lithography tools. So right now, that's a big chokepoint because to get the most advanced architectures and feature sizes for semiconductors you need EUV.

And the other two chokepoints, as you get smaller and smaller feature sizes, other parts of the tool-making sector

become important. So etch, this is the stage after the lithography, you etch away using various chemicals and advanced tools, the different pieces to expose the underlying circuit. And so as part of the lithography process, you're putting a mask down and then the next step is etching. And in EUV lithography, you really need really good etching equipment to do this. And there, US toolmakers like LAM and Applied Materials and TEL from Japan are also really important players there.

And then finally, there's the other chokepoints in terms of the ability to put all these tools together and manufacture something at that advanced feature length. TSMC, Taiwan Semiconductor Manufacturing Corporation, it turned out that their business model became a chokepoint because their model was, "We'll focus just on the manufacturing process, and we won't compete with our clients." And so other foundries like Intel and Samsung are also making devices of their own, but TSMC became the trusted go-to player in part because they weren't competing with their clients and in part because they're just really good at engineering. And they've developed trusted relationships with both the toolmakers and their clients. And so they're able to uniquely push the manufacturing innovation to the

needs of their customers. And so that model proved to be really amazing. So now they produce over 90% of the most advanced nodes.

Allison Nathan: So is it possible for any country to become self-sufficient in semiconductors?

Paul Triolo: If anybody can do this, it's probably China and Chinese companies because it's a big country, they have a lot of STEM education programs, and they're cranking out a lot of engineers per year. They have the incentive now because of US export controls and they'd been largely cut off from access to EUV. Starting in around 2018, the US, working the allied partners, basically was able to prevent Chinese companies from purchasing EUV equipment.

And so since then, the Chinese system has been trying to figure out how do we develop all of these parallel technologies that you need to develop EUV? But what makes lithography so difficult is that it's really a systems integration problem. So you're integrating complex systems at scale; optics, the light source, lots of software, and lots of little pieces of the puzzle and also materials like

photoresists so that lithography has to work with photoresists. And then it has to work with all these other tools that are part of the manufacturing process.

And also the really important and hard part is to service these pieces of equipment because they're very delicate. As one industry insider once told me, he said it's easy to build a prototype, for example, but it's really hard to service hundreds of these things 24/7, operating in foundries, to keep them up and running because, in addition to being complex machinery, they need spare parts, software updates, and you need a really capable workforce to be able to support deployments of those complex tools for very demanding customers worldwide that are expecting maximum up time and very few defects. And so that's part of the challenge is you need a lot of very seasoned engineers to service that.

And companies that are manufacturing millions of semiconductors at the cutting edge, they're going to be reluctant to risk an unproven technology.

Allison Nathan: You mentioned export restrictions to China. It would be useful to get your answer on how

effective those policies have been in slowing China's progress towards its own self-sufficiency and everything it's trying to pursue in terms of AI.

Paul Triolo: Yeah, the US has prevented the sale of the most advanced GPUs to China. GPUs are the unit, if you will, of compute for developing advanced AI models. So the US policies have been effective in cutting off access, but it's a little bit more complicated than that because the cutting off of access has forced the Chinese industry to get better. There has been a collateral effect both on the semiconductor manufacturing side and on the GPU design and development side, forcing Chinese companies to get better to be able to develop alternative capabilities. And so we're in the middle of that process right now.

In terms of the effectiveness, I guess the outcome remains to be seen. If China, for example, is capable of developing a pretty good alternative supply chain for manufacturing that allows it to manufacture GPUs that are maybe not as good as Nvidia's but are pretty good and enable them to develop advanced AI models that are pretty good and competitive then we have to reassess the effectiveness of them. So the effectiveness depends on what the goal is, and that really is

the second part of your question which is China's ability to develop advanced AI models.

And there, all of the leading open-source and open-weight models are all Chinese. They're all from companies like Alibaba, Tencent, Baidu, Moonshot, Zhipu AI, and DeepSeek, and that's a really weird situation, right? So if the US has controlled semiconductors to slow China's AI development but Chinese companies have access to older Nvidia chips and to new Huawei chips and GPUs and also developing their own internal in-house chips have been able to continue to design very capable AI models.

And a year ago, this wasn't the case. A year ago, the leaderboards, for example, in the open-source, open-weight model arena were Meta and US companies and Mistral from France. But now they're all Chinese companies because the Chinese companies like DeepSeek decided to go the open-source route, and that's allowed a lot of rapid innovation. So right now, the leading models are being developed in the US at OpenAI and Anthropic, which are both closed proprietary models, but in terms of uptake of models, because Chinese models are open-source, open-weight models and are cheaper to initially deploy -- all of

those open-source models are being more and more used by companies, so that's a really interesting trend.

And so when you talk about slowing down China, the issue of diffusion of these models is not often discussed, but it's an important thing because the success of AI is based on the development of capabilities and models and also who's using it. But really almost more important right now is the deployment of these models in business.

And the Chinese government has been pursuing policies to try to help companies like DeepSeek by building data centers all over China. So the Chinese government has tried to build out a supporting infrastructure nationally, both in terms of power and in terms of data centers and make it a little bit easier for Chinese companies to gain access to compute.

The bigger AI labs like Alibaba and Tencent and Baidu have their own cloud-based infrastructure. And so for them, they don't really need data centers to support them. But other smaller companies don't necessarily have the capability to have their own massive cluster of data centers to design their models. So for those companies, it'll be

having access to compute will be important.

Allison Nathan: We've also heard the argument that China's dominance in rare earths and its abundant power supplies gives it significant advantages over the US in the AI race. Is that true?

Paul Triolo: The rare earths issue is less salient arguably in terms of the AI data center build-out. It's more important for industries right now like the auto industry, even consumer electronics, and of course defense and aerospace where things like magnets come into play.

Now, magnets are important also in the semiconductor industry, but really small numbers there. And the Chinese are issuing licenses for those. So rare earths are going to be a constant irritation, but they're not going to really affect I think the build-out of largescale AI infrastructure. But energy is going to be this big gating function.

Power is going to be in the US a huge constraint on the build-out of these data centers because these data centers require a lot of power, constant stable power. And if you look at all the alternatives in the US, for example, nuclear

and natural gas, things like turbines and transformers, there's a huge supply chain problem in the US in terms of supplying sufficient quantities of hardware really to generate enough energy. And we don't have a unified grid either, which China also has, that makes it easier to move power from place to place. Because of that power issue that the US has, probably a lot of data centers will get built in the Middle East, and US companies will use those just because the Middle East has access to so much fairly cheap power.

Allison Nathan: So who will ultimately prevail in the AI race? The US or China?

Paul Triolo: First of all, the premise that the US will be able to stay ahead is premised on the idea of scaling. The idea that the more GPUs, the more compute you throw at these models, the better they will get. And the jury's still out on that. A lot of it depends of course on the ability of the Chinese semiconductor industry to overcome some of those hardware chokepoints that we mentioned earlier.

China's big disadvantage frankly is they didn't pay attention to semiconductors ‘60s and much in the '70s. So

they lost two decades or more of focus on an industry, while in the US there was a lot of attention being paid to developing the semiconductor industry. And China had the disadvantage of underdeveloped capital markets. The US had the luxury of a lot of patient capital in helping to finance the development of our semiconductor industry, and China just doesn't have that. So the government has to play a bigger role.

As I said, the only country in the world that could even conceive of trying to recreate large parts of the semiconductor supply chain is China because they do have the numbers of engineers, and they do have the government resource incentive now to do this. But we don't have any other example of this being done to compare to, right? So it's hard to assess how successful they will be.

Allison Nathan: There seems to be a perception from where I sit in the US that the US is leading the tech race, especially when it comes to AI. But perhaps the most striking takeaway I have from my conversations from Mark and Paul is that China has a lot of advantages over the US, and that could lead to China ultimately coming out ahead.

That would be especially the case if China has more access to advanced US chips, and that's the direction US policymakers seem to be moving in, at least this week.

Let's leave it there. My thanks to Mark Kennedy and Paul Triolo. And thank you for listening to this episode of Goldman Sachs Exchanges. I'm Allison Nathan.

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