

Exchanges at Goldman Sachs
The Global Chip Shortage: Impact, Outlook and Recovery
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Allison Nathan: This is Exchanges at Goldman Sachs and I'm Allison Nathan of Goldman Sachs Research. Today, we're going to explore the global chip shortage and why it's causing major real-world consequences. To do that, I'm joined by three of my colleagues in Goldman Sachs Research -- Toshiya Hari, Kota Yuzawa and Rod Hall. We'll first turn to Toshiya, who covers the US semiconductor sectors for us. Toshiya, welcome to the program.

Toshiya Hari: Thanks for having me, Allison.

Allison Nathan: Toshiya, the semiconductor chip shortage is impacting so many industries. We're seeing nearly daily stories about another industry being disrupted by it. Rewind the clock for us and describe how the industry got to this point.

Toshiya Hari: Sure. So if we rewind the clock to early 2020, the semiconductor industry had just gone through a prolonged downturn driven primarily by an inventory production in the supply chain and in our view was on the verge of a cyclical upturn. But then COVID hit in the spring, and the knee-jerk reaction on the part of the customers of the semiconductor companies that we cover was to reduce or cancel orders in anticipation of a weaker demand environment.

What transpired immediately post the emergence of COVID and during the pandemic was very different though. And if anything, the complete reverse happened in many applications. Many of us working from home, learning from home, went out and bought things like PCs, game consoles, WiFi routers. And demand for cars increased as well as people moved to the suburbs and avoided taking public transportation.

On the supply side of the equation, not only did the suppliers step on the brakes when customers reduced or canceled orders,

but the lockdown measures that were in place across many regions made it very difficult for the supply chain to react and to increase production. And furthermore, there have been a number of exogenous events or natural disasters -- for example, the winter storm in Texas earlier this year -- that have been disruptive to supply recovering over time.

So in a nutshell, Allison, the shortage has been caused by a combination of better-than-expected demand and also a very bumpy recovery on the supply side.

Allison Nathan: You mentioned some reasons why supply is taking so long to respond, but it's been over a year now. So what explains that length of delay?

Toshiya Hari: Of course. So it does take a very long time for semiconductor companies to increase output. It takes time to purchase the tools. It takes time to install the tools. And the actual manufacturing of the chips takes a couple of months as well. To give you some context, for a front-end wafer processing tool, the lead times can be as long as six to nine months, sometimes longer. Installing and testing the tools before going into mass production can take several weeks or a couple of months depending on the factory. And the actual production of a semiconductor chip can be as long as three to four months depending on the device type.

So assuming many companies in the industry came to the realization that there was going to be a severe shortage of chips in late '20 or early 2021 and placed equipment orders then, they're likely accepting delivery of those tools just around now or sometime in Q3 and would have access to the actual input on in Q4. And this is all assuming that a company already had the fab space and the clean room in place. To the extent a company is starting from scratch or a plot of land, it would take multiple years as opposed to multiple quarters.

Allison Nathan: So when do you expect the situation to get better?

Toshiya Hari: We do think peak shortage is in Q2, so the current quarter. We expect tightness to ease somewhat in Q3, more so into Q4, and definitely into 2022. That said, given the expectation for companies up and down the supply chain to restock inventory to a level that exceeds pre-pandemic levels, we would expect another couple of quarters of strong semiconductor sell in for the entire supply chain to be

comfortable with overall inventory levels.

Allison Nathan: So in the wake of all this, are semiconductor companies making any longer term changes to their supply chains? And what about customers or policymakers? Are there any efforts there to reduce the strains on the industry?

Toshiya Hari: Right. So in the short term, clearly companies are increasing CapEx and trying to address the shortage through I suppose traditional measures. The one big change that appears to be happening, which is a little bit more fundamental structural long term, is customers and customers' customers are increasingly willing to share their medium- to long-term demand forecast with the supplier base. And more importantly, in some cases, they're willing to sign long-term contracts that provide more transparency and more predictability for the supplier. This way the semiconductor companies can plan ahead, and they can invest with less hesitation which in turn will reduce the risk of severe shortages for the customer going forward as well.

Separate from this, you're seeing sovereign states -- not just the United States but governments around the world -- getting involved. Many governments have announced funding for the semiconductor industry. Some governments are in the process of writing up policies to fund the domestic semiconductor industries to A) address the shortage, B) create more robust local supply chains, and C) for national security purposes as well.

Companies like Intel and TSMC have publicly stated their intention to build capacity in the US, also in Europe. So I think that's the only fundamental change that seems to be happening in response to the current shortage of semiconductors.

Allison Nathan: So what does all this mean for investors and for semiconductor stocks?

Toshiya Hari: The big enemy, if you will, for semiconductor stocks, the industry historically really to this day has been volatility or cyclicalities. The peak-to-trough and trough-to-peak changes again historically have been really, really large. And frankly that's been the biggest reason for these stocks to be trading at a significant discount to the broader market. To the extent there's tighter collaboration between the suppliers and the customers, again in the form of, for example, long-term contracts and to the extent the volatility and the cyclicalities is reduced going forward, that should show up in the form of

higher multiples for these stocks, whether it be the semiconductor stocks or the semi cap equipment stocks. And that should obviously serve as a positive for the investor base as well.

Allison Nathan: Sounds like this is going to continue to unfold. Thanks so much for laying this all out for us today, Toshiya.

Toshiya Hari: Thank you for having me.

Allison Nathan: We'll now turn to Kota Yuzawa of Goldman Sachs Research in Tokyo, who's been covering the auto and auto parts sector for more than 15 years. Kota, welcome to the program.

Kota Yuzawa: Hi. Thank you for having me.

Allison Nathan: Kota, the automakers have been among the hardest hit by the chip shortage. Can you explain the factors that have made this industry so vulnerable?

Kota Yuzawa: Sure. I think there are a couple of things. First of all, auto accounts for less than 10% of the global semiconductor supply. And on the back of COVID-19 situation, there was a severe allocation battle built when auto semiconductor and the consumer semiconductor, and historically auto semiconductor is less profitable business for semiconductor companies. So it's very easy to make use of auto semiconductor wafer factory into the consumer accounts because it doesn't lead to additional line sophistication, but a smartphone semiconductor wafer factory cannot be used for auto semiconductor.

So what happened is that there was a big decline in auto demand on the back of COVID-19. All the automakers slashed orders to the TSMC. But at the same time, there was another very big demand increase all of a sudden. Then you cannot really easily switch around the wafer by application, and it getting increasingly difficult for wafer companies or semiconductor companies to allocate more wafer to auto industry.

Secondly, to make things worse, mainstay semiconductor factory at Renesas which is the number one auto micro chip company in Japan had a fire incident back in March. They are ramping up slowly to the 100% level utilization rate by the end of July, but it takes some time.

And then finally, cars are getting increasingly complicated.

You have electrification going on. You have autonomous features. So semi contents per people has been growing from somewhere around \$300 US five or six years ago, now it's about \$600 US, and it keeps growing.

Allison Nathan: So is the chip shortage expected to impact global auto production this year?

Kota Yuzawa: Yes. So we estimated roughly 3% lost production due to semiconductor shortage in 2021. We're seeing severe supply shortage problems, especially in this June quarter, and it's going to get better into the September quarter. So 3% production loss looks very small number, but it's translated into \$15 to \$20 billion US operating profit losses for global automakers, which accounts for 10-15% of the global auto profit pool.

Allison Nathan: So have we seen the peak in disruptions? Or when do you expect the supply-demand situation to normalize?

Kota Yuzawa: Yes, so Renesas situation that we spoke is getting better. They restarted operation late May and will have proper wafer out starting from end of July. So that semiconductor company problem will get resolved within a couple of months. But on the other hand, as we spoke, there are increasing demands for contents per people. And we are having significant supply-demand shortage at Taiwan's foundries and semiconductor companies such as TSMC. So we are seeing a structural supply-demand tightness for semiconductors for auto application. And we are expecting this tightness will continue throughout 2022.

There are significant CapEx announcements from various auto semiconductor companies in the past six months. So we are hoping some kind of capacity addition will have a positive impact for the supply-demand sometime in 2023. But over the next 12-18 months, I am pretty sure that supply-demand tightness will continue for semiconductors.

Allison Nathan: So the chip shortage has not only shown how dependent the car industry is on a few suppliers but also how vulnerable it is to disruptions. Are automakers taking this away and reevaluating their manufacturing supply chains? And if so, what are some of the changes they're considering?

Kota Yuzawa: Yes, so there are very big gaps when it comes to the semiconductor supply-demand tightness. I think in particular Toyota did a very good job managing the semiconductor

short supply. I think Toyota is taking a good balance between just-in-case and just-in-time production systems. Historically, Toyota was a pioneer of the just-in-time management, trying to see how very little inventory to generate a very good working capital and also tried to identify the customers' needs and being very flexible in terms of in-demand situations.

They experienced a very, very severe supply constraint when we had our Tohoku greater earthquake in Tokyo 10 years ago. Toyota decided to go with adjusting case management for critical components such as semiconductors. And since then, they decided to keep at least four months of critical parts inventory, and that is having a positive impact for their production system. I think other automakers might have to follow Toyota's practice and try to take a good balance between just-in-time and just-in-case. Less inventory is actually positive for your working capital, but in order to cope with this special situation like this, just-in-case management probably makes a lot of sense.

Allison Nathan: So lastly, let me ask you about the car market. If I want to buy a car right now, new or used, how is this affecting me?

Kota Yuzawa: It is having a very, very big impact, especially on the used car market, global basis. And if you take a look at the US auto market, used car price actually doubled over the past six months on the back of special demand created by COVID-19 and also the supply-demand tightness of the car vehicle itself.

Also, we are having pricing impact in the new car market, which is positive for carmakers but probably not good news for end users like you. We have seen roughly \$1,000 US dollar per vehicle discount shrinkage back in May. And we will continue to see very good favorable pricing environment for auto industry. Meaning that consumers will have to pay a certain amount of money for this supply-demand tightness.

Allison Nathan: And how long do you think that will last?

Kota Yuzawa: Yes, so things will probably get better into the September quarter and most likely come back to the normal situation into December quarter. But having said that, we are seeing tightness in supply-demand throughout 2022. So I think the worst is over in terms of the semiconductor shortage, but the pricing environment continues to be very favorable for auto industry over the next 18 months.

Allison Nathan: Thanks so much for joining us today, Kota.

Kota Yuzawa: Thank you very much for having me.

Allison Nathan: And last but certainly not least, we'll be speaking with Rod Hall, who covers the hardware and communications technology sectors for Goldman Sachs Research. Rod, welcome to the program.

Rod Hall: Thanks, Allison.

Allison Nathan: Rod, so we heard earlier from Toshiya, who explained how consumer demand for things like PCs and game consoles skyrocketed during the pandemic. Were the hardware and communications tech sectors able to meet that demand? Talk a little bit about how the chip shortage has affected these industries.

Rod Hall: Yeah, thanks. It's been really varied, Allison. It depends on which particular consumer electronics piece of technology or product we're talking about. But PCs have definitely been short. We've been unable to supply enough PCs to consumers, and that makes a lot of sense considering we're all working at home and probably upgrading our PCs. iPads have also been in short supply. Apple said there's \$3-4 billion worth of iPad revenue that will roll into the September quarter because they can't supply enough of those. A lot of that is educational demand. So those two categories, things that cross over between business and education, have really been in short supply.

We've seen less shortage in products like TVs and home audio and things like that. A lot of demand but there was enough inventory to cover those products.

Allison Nathan: You mentioned Apple. They're obviously a bellwether of consumer electronic companies. What have they been experiencing during this period?

Rod Hall: So with regards to Apple, we've seen a mixture of demand. Generally speaking, demand's been very strong. iPad revenue growth is about 70% this last quarter compared to five years of flat revenue growth. The same is true for Mac. We've seen very strong revenue growth in the last couple of quarters compared to five years of flat revenue growth. So Apple's been very positively impacted in those technologies that help people

work and study from home. The iPhone also probably has been impacted less from a unit point of view but more from a revenue point of view because of the ASP. So people are buying more expensive phones we think as a result of government subsidies and also the fact that consumers have so much disposable income to apply to these technology products.

Allison Nathan: And so if you look at the new demand that you're seeing, has it pulled forward demand? Should we expect demand to be weaker at some point in the future because of this?

Rod Hall: Yeah, this is a matter of great debate. We believe it has pulled forward demand. We think that those statistics I just threw out are pretty informative that you've seen no growth in these categories for years, and yet all of a sudden we've seen an incredible amount of growth. I think that we believe that that pull forward may attenuate over time as opposed to just immediately drop off in a binary way. So there's a little bit of debate in our minds about how fast this attenuates. But whether or not it attenuates, I think we have pulled forward quite a bit of demand and we'll see somewhere out in the next 18 months a falloff of demand as consumers move their spending to other areas like going on vacation, for example.

Allison Nathan: So what's the outlook for the sector overall?

Rod Hall: Well, overall, we think for consumer electronics the outlook's pretty poor. You know, right now we're seeing incredibly high demand. That'll be followed by a period of weakness as we normalize. And then we'll come out the other side of that to a more normal world, but that may not happen for a couple years.

We haven't talked about the IT hardware part of this. The servers, compute, storage, networking, all those products are probably going to be in a little bit higher demand. We particularly think campus networking and things that enable people to do Zoom calls and all kinds of other digital interaction on campuses as they go back to offices will be in high demand. So couples like Cisco, for example, should benefit from that.

Allison Nathan: Actually, let me just clarify that. But aren't we leaving Zoom in the rearview mirror a little bit? So why do you think those sectors will benefit?

Rod Hall: Well, we're moving to a little bit more hybrid way of

working, in my mind. I think all of us want to be back in offices. All of us see a lot of benefit to being together. Personally, I know that we in Goldman Sachs's San Francisco office has opened up more, and we all saw each other last week, which was great.

I think that at the same time, people have learned that these technologies can be leveraged for greater efficiency, where when we're traveling maybe people will be working from home a little bit more. Those times you want to be able to integrate people in the office with people that aren't in the office. And Zoom we've all learned is a great way to do that. But we need to enable that in the office. We need greater network capacity to support all this video traffic. It loads networks substantially more than voice. So that's the reason that we think these technologies are going to be really in demand the next couple of years by companies trying to make sure that can work in the office the same way as it does at home.

Allison Nathan: Right. It does feel like the future of work is evolving here, and some of what we've seen will persist. Thank you so much for joining us today, Rod.

Rod Hall: Sure, Allison. My pleasure.

Allison Nathan: That concludes this episode of Exchanges at Goldman Sachs. Thanks for listening, and if you enjoyed the show we hope you subscribe on Apple Podcasts and leave a rating and comment. This podcast was recorded the week of June 21st, 2021.

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