

# Autonomous Vehicles: An Evolution, Not Revolution

## Disruptive Forces in Investing

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**Anu Rajakumar:** Welcome to *Disruptive Forces*, a podcast from Neuberger Berman where we delve into a range of innovative topics in the world of investing. I'm your host, Anu Rajakumar, and our first episode is about autonomous vehicles. I'm joined today by Michael Barr, an analyst with Neuberger Berman's Global Equity Research Department. Michael, thank you for being here.

**Michael Barr:** Thank you.

**Anu:** Now, the shift towards autonomous vehicles and self-driving cars is clearly a megatrend that's totally redefining the traditional car industry. Tell me about how this space has evolved over the past few years, and some of the advancements that you expect to see in the future.

**Michael:** Yeah, I think that's a good point. I think this is an evolution, not a revolution. I think you're starting to see the building blocks of autonomous vehicles today. I know a lot of people think the end state of autonomous vehicles, and that's true, but to get to the end state there's a lot of stuff you need to do.

**Anu:** So the Jetsons are not happening tomorrow.

**Michael:** Not happening tomorrow, but the stuff that can help that come true is happening. So, for example, we all know backup cameras, most people have blind spot monitoring, autonomous braking for when sensors are off, you've seen those commercials for autonomous braking, they've gotten quite powerful recently. Those are all building blocks to lead us to autonomous vehicles. And what's happening now is we're seeing an industry that is used to being owned by the consumer, demanding a product on their car or automobile, and not really willing to pay for it. Now these consumers are demanding the product but willing to pay for it because they understand the safety ramifications. This is pretty much unheard of in the auto industry. And more to that point, a lot of the auto companies are actually able to make a profit on it. So historically we think about other safety features like the airbag or the seatbelts, those were demanded by the customer and they were just provided by the OEMs. Today some of these blind spot monitoring systems cost money, and the consumers want to pay for it, and this is a significant change. But all of this is allowing the automobile to be smarter and allowing the automobile to be safer, and consumers are understanding that, and the OEMs are willing to supply it. So this isn't an end state goal, this is a building block into what eventually will be fully autonomous vehicles.

**Anu:** And when we think about that end state, I've heard that autonomous vehicles will be the greatest transformation since the combustible engine. Do you agree with that?

**Michael:** You know, we do agree with that. There's a lot of analogies that we can put in place, and we all are familiar with ride sharing companies. The ride sharing companies are very familiar to every one of us, and provide a nice ability to travel without the threat or risk of owning a car. But that's kind of a nice to have, not need to have right now. When we think about what this autonomous vehicle capability can become, we think a lot of it is how the streaming has changed the way we view television, right? We used to watch television, maybe recently used a DVR, and now the streaming capabilities have really changed how we watch television, where we watch television and the like. We think as autonomous vehicles get into a ride sharing network, to become the "robo-taxis" going around city centers, we think that has the capability to be the streaming video, the internal combustion engine which really allowed people to get around. We think it's really going to completely change not only the way people move themselves around cities and states, but also basically the way we think about transportation.

**Anu:** Right, so this technology is really just going to be an amazing force that's going to change and revolutionize the way that we move.

**Michael:** I think it's to the point where the consuming public is still not aware how transformational this is going to become for them.

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**Anu:** And speaking of the ride sharing companies, what I've noticed is there are some interesting collaborations going on, these companies aren't just working in solidarity, they're working alongside some of the technology companies. Can you walk us through some of those collaborations?

**Michael:** Yeah, the ride sharing is basically a fascinating aspect, and the amount of market share that they've been able to capture is staggering, but in the grand scheme of things they're still the only about 1 percent of total miles travelled. So there's still a lot of opportunity to improve the adoption rate of this. There are a lot of these collaborations going on. We think it's a lot of the companies are realizing that this is a very difficult task, achievable, but difficult, and it's an expensive task but the payoffs are well worth it. So they're trying to find ways to work together to get to the end result. One that's going on right now that's the most public is Aptiv is collaborating with Lyft in Las Vegas. So if you go to Las Vegas and you pull up your Lyft app, you can request an autonomous vehicle to take you around what's called a geofenced area, so it's a predefined space within Las Vegas, but you can have an autonomous vehicle take you. In fairness, they're safety drivers, which I assume everybody will like at the time because this is a trial run, but you're able to actually be in an autonomous vehicle today. To your point, Lyft recently announced that they are going to have the same sort of collaboration with Waymo in Phoenix, Arizona, starting in 2Q. So now you have two spots in the US where you're going to be able to actually get in an autonomous vehicle. Now, it's been widely successful. They're utilizing the fleet roughly 65 percent of the time. Compare that to an average car utilization rate of around 3 to 5 percent, so you can see the economic benefits of it. From a ride sharing point of view, it's very attractive because about two-thirds of the cost of a ride sharing network goes to the driver. So if you can remove the driver, you can remove significant amount of costs, but more specifically if you remove a significant amount of costs you actually lower the price for the consumer. So it builds with the adoption rate. There's also a lot of information that can come off these cars, and they're sharing that with each other and they're sharing that with the casinos. So, for example, there are times when one casino is known to have a lot of demand at 2 pm. It's very hard to organize – if you're a ride sharing company it's very hard for you to organize your driver fleet, but what you can do is take all of your robo-taxi fleet and tell them to be at the casino ten minutes to two to service the demand and the customers coming out of that casino. That's benefit for the ride sharing, that's benefit for the casino. Another example is they find out that a lot of people are leaving a casino and going to specific restaurants, and specific types of food. That types of food is not provided inside the casino, and a casino's job is to keep everybody in their four walls, right? So you can find out that, oh, we might need to add a steak option to our restaurant buffet. And these are the ways that you can share and educate and make everything more efficient.

**Anu:** Very exciting. Now, ESG is something that a lot of investors think about across a wide range of sectors and industries. How do you think about these environmental, social and governance factors when it comes to autonomous vehicles?

**Michael:** So from an ESG point of view, there's a lot of touchpoints that autonomous vehicles hit on. The first one is unfortunately there are roughly 1.2 million deaths last year; 94 percent of those were caused by human error, and most of those were caused by distracted human error. And any way we can make the car safer and more reliable is going to cut down on those accidents. There's been studies shown that some of these capabilities that we're already putting on the car today, like autonomous braking, blind spot monitoring, can reduce accidents by 45 to 60 percent, today, without a lot of computer systems that will eventually be on an autonomous vehicle. So we think being able to reduce deaths is a very positive aspect. The other thing that people worry about is jobs. And when we sit back and think about it, there's a pilot going on where – there's a long haul trucking test pilot going on. And the long haul truck market is – the employee base of the long haul truck market is basically 55 years old, on average. And it's not an exceptionally desirable job. Most people want to stay regional, they don't want to be on the road four to five days in the week. And what's happening is we think this technology isn't going to displace these workers, instead it's going to help with attrition as it's becoming harder and harder to hire these long haul truckers. The autonomous capability can provide long haul capabilities while you will still need truckers and truck drivers for more of the regional point and end point, and from distribution to end point. So I think that that's a risk that people worry about that we don't really see as aggressively. And finally, on an environmental point of view, if you can have an autonomous fleet that goes the speed limit, allows for proper merging, doesn't rubberneck at any issues, there's less traffic, and there's more efficiency on the commute. That less traffic and more efficiency leads to less carbon dioxide in the air. The other thing we also think is the best platform for an autonomous vehicle is an electric vehicle. So that just takes it one step further; as there's more electric vehicles on the road, there's less pollution, and we really think this is environmentally a better place for the globe.

**Anu:** Well, then that leads me to my next question, which is about regulation, and how are governments going to be able to keep up with this new emerging and changing technology.

**Michael:** Right, that's a fair question. And we all know there's risks with all new technology, so we acknowledge those risks. And from our point of view the biggest risk to the timeline is the regulation. So the technology, in our opinion, is proving itself out. There's a lot of pilots, there's a lot of tests going on right now that are proving the technology, and we think the technology is actually moving ahead at a faster clip than we would've thought two years ago. What is unknown is the regulatory front, and how – from a federal point of view, so states such as California, Nevada, Arizona, Florida have been very proactive, but how is this going to evolve into a federal point of view is still an

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unknown, and we think that if we were going to use the timeline, that's the biggest risk to the timeline. We still think it's going to be late 2020s when you're going to have fully robotic, full fleets of these robo-taxis in the road, not just pockets of test vehicles like you're seeing in Las Vegas and you're seeing in Phoenix right now. But we think mass scale is probably in the middle to late 2020s, regardless of this regulatory risk. But we do think that is the biggest near term risk.

**Anu:** And you've spoken a lot about developments in the US. Can you share some thoughts about how this is playing out elsewhere in the world, in Asia, Europe, or if there are any governments or markets that are particularly focused on making autonomous vehicles come to fruition quicker?

**Michael:** So the U.S. is being very aggressive with the autonomous vehicle testing. Another country that's been very aggressive is Singapore. Singapore is very much a connected country, so it is a nice place to test. They've already – a lot of their vehicles are already connected, there's a lot of regulations around vehicles, so there's a lot of testing going on in Singapore, and we would say they're right there up there with the US. China is starting to test their vehicles, and Japan is definitely up there with everybody else. One thing to note is Japan they're working on trying to provide autonomous vehicles for the 2020 Olympics to shuttle a lot of the customers and the people coming to watch the Olympics, as well as some of the athletes, around the Olympic Village and to some of the destinations. So we'll keep an eye out on that, but that just gives a flavor of how it's globally being tested around the world.

**Anu:** Now, I'm curious to know if there's any industry sector occupation that you think will be indirectly affected or even something that will be created by self-driving cars that people might not immediately be thinking about.

**Michael:** When we think about it, that's a good question, and when we think about it, we really think the city landscape is going to greatly change as robo-taxis become prevalent throughout the U.S. and throughout the world. And if you think about it, if you have a robo-taxi fleet in a dense urban area, which is their, in our opinion, their core business case for them. If you have a robo-taxi in a dense urban area, you won't need sidewalk parking, you won't need garages, because there's no reason for them to park. Right? How does that change the city landscape? Will there be more parks? Will there be more housing? Will there be more stores? The other thing to think about is as the autonomous vehicles come to fruition, how are people going to commute to work? Will the expanse of how far you want to live away from your job change because you're able to get there more efficiently, you're able to get there while working in the back of your car? The other thing that you can think about from an autonomous vehicle is that if you're that person who commutes in an autonomous vehicle, you're either able to, one, send your car back home when you're done, and the rest of your family can use it for the rest of the day, or, two, maybe you want to put it into a ride sharing network and it goes out and makes money for you while you're actually working and trying to make money as well. And then when it's time for you to go home, you summon the car back and it takes you home. So there's a – it sounds like a lot of science fiction and imagination, but these are all business cases that can really happen for the industry as this technology advances. And to your point, what can really change, I think what people would be most surprised about is how city infrastructure is going to change as we start removing some vehicles from that area.

**Anu:** Yeah, I think that's actually quite fascinating to think that even car ownership might just drastically change, and that you maybe don't need to have as many carparks or garages as you previously had, and maybe more green spaces in urban areas could certainly change our landscapes. We talked about the end state for autonomous vehicles in this episode, which could be a number of years away. What are your thoughts on how investors can look to capture value in the shorter term?

**Michael:** Right, so autonomous vehicle is the end state, and that's what everybody thinks of when the conversation happens, but in truth be told, as we talked about at the beginning of this podcast, is there's a lot of technology that is being put on the car right now that we are purchasing right now as consumers. And this technology is generating revenues and cash flows for a lot of companies, both in the auto industry and in the tech industry, so there's a lot of industries that are benefiting from this move and, if you will, this building blocks towards autonomous vehicles. And when you think about the size of the auto industry, which is roughly 100, 90 to 100 million units produced each year, and as you build the content on each one of these cars, you build the acceptance of this technology, there's a lot of revenue and economic opportunity that exists in a lot of industries as this technology advances.

**Anu:** Well, Michael, this has been totally fascinating. I've loved learning about the evolution of the autonomous vehicles and how different companies are approaching this challenge, so thank you so much for being here.

**Michael:** Thank you.

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