

Q-Series

How disruptive will a mass adoption of robotaxis be?

Equities

Global

Automobiles

The path towards mass adoption of robotaxis

Robotaxis will likely price-compete with mass-transit systems. The shift towards electric autonomous vehicles, combined with more advanced fleet optimization and servicing platforms, next-generation traffic management and more intense competition, should reduce the fee charged to passengers of robotaxis by as much as 80% versus a ride-on-demand trip today. The technology to make robotaxis a reality is already available. In this new paradigm, owning a private car will cost almost twice as much as using robotaxis regularly. In this report, we connect the dots between key auto megatrends and discuss the disruptions arising from the future mass adoption of robotaxis.

Robotaxi benefits to overcome adoption and regulatory inertia

Despite backlashes against disruptive platforms, we believe the benefits of robotaxis will eventually converge into a broadly embraced commercial offering. Selected benefits include: (1) access to a cheaper and higher-quality alternative to mass transit; (2) households saving up to €5,000 a year in car expenses; (3) fewer traffic accidents; (4) more advanced traffic optimization (such as road junctions without traffic lights).

Despite uncertainties, impact on participants likely significant

The conclusions of this report depend on some critical assumptions (such as peak/off-peak demand and the adoption curve), but our scenarios are anchored on interviews with experts, academic work, government information and our own proprietary data, e.g., UBS Evidence Lab surveyed over 15,000 consumers (third update) and Uber pricing data for ~70 countries (second update). We found almost two-thirds of respondents are willing to ride in an autonomous vehicle. One of our scenarios translates into: (1) new car sales running 10% below trend in the long run; (2) the urban fleet size halving; (3) EV penetration accelerating; and (4) a sharp increase in the number of kilometres driven globally. Two interactive models allow readers to test their own assumptions.

We highlight new business models and specific names impacted by the theme

Business models for OEMs could change significantly in a high-robotaxi-penetration scenario: OEMs could enter new areas such as fleet or physical asset management, even adding revenue streams that today are captured by telcos and media companies. OEM earnings streams should become more stable, but managing the transition could be a challenge. Ultimately, we see winning shared-mobility platforms and OEMs working together. The report also discusses the impact on nine sectors ranging from insurance to batteries; and we present a broad list of stocks impacted on page 14.

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Executive summary

Why read on?

Robotaxis will likely compete with mass-transit systems. The shift towards electric and autonomous vehicles, combined with intensifying competition, should reduce the fee charged to passengers by as much as 80% compared to today. Within the next few years, the technology will be available to make robotaxis a reality. In this new paradigm, owning a private car will cost almost twice as much as using robotaxis. We think regulation will facilitate the transition as: (1) the population will have wider access to mobility within the urban environment; (2) each household could save €5,000/year; and (3) the technology will reduce the number of car accidents.

We have extensively written on electric cars and autonomous/connected vehicles. In this report, we connect the dots and try to answer four key investment debates: (1) are consumers ready to ride in robotaxis?; (2) what does the shift towards electric, autonomous and shared vehicles ('robotaxis') mean for the cost of a kilometre travelled?; (3) how will the business model of the auto OEMs evolve in this new paradigm and how can they reinvent themselves?; and (4) what are the implications for the auto industry in terms of new car sales, car parc size, fleet mix, number of kilometres driven, and what are the implications for other sectors?

We have leveraged UBS Evidence Lab to run our **third consumer survey on shared mobility**, our **fifth smartphone app download analysis on ride-on-demand**, and our **second UberX pricing analysis**.

We have also built **two interactive models**, available on UBS Neo: (1) to compare the daily commute costs in 17 cities globally using a private car, a ride-on-demand vehicle and a robotaxi, and to estimate how much users could save by switching to robotaxis; and (2) to gauge the impact of a shift towards robotaxis on new car sales, fleet size and number of kilometres driven. Our work is also based on close to **ten expert events** we have hosted on the shared mobility topic over the past year.

The concept of robotaxis strongly overlaps with the concept of shared mobility, which is clearly gaining momentum in the investment community, as OEMs have become more active by taking equity stakes in shared mobility platforms and investors try to measure the impact on carmakers of the shift towards electric, autonomous and shared vehicles.

Key investment debates

Riding towards free transport: what do robotaxis mean for the cost of a trip?

We undertook a deep-dive analysis of how the cost of a kilometre travelled could evolve as we move towards "electric autonomous shared" vehicles, or robotaxis. The cost of running a car will decline sharply in this new world.

In our highlighted scenario, we are assuming that competition will eventually force platforms to fully transfer the benefit to end users.

The technology will be available to make robotaxis a reality within the next few years

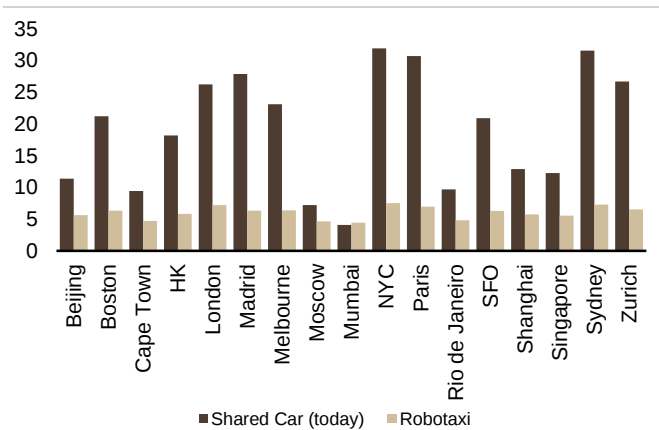
In this report, we connect the dots and try to answer four key investment debates

Actively using the UBS Evidence Lab toolkit

We forecast that the cost per kilometre for the user of a robotaxi could be half that of owning a private car today (assuming one passenger per vehicle). The cost of the daily commute to work could fall from €24 per day in a private car to €7.2 per day (assuming two passengers per vehicle). Getting rid of their private car would enable the shared mobility user to travel about 10,000km per year in a robotaxi (Figure 2) and save €5,000 per year. We also estimate that the fee charged by the platforms that connect supply and demand for trips could shrink by almost 80%, compared to today. We have built an interactive model (available on UBS Neo), which enables investors to select the city they live in and compare the relative costs of owning a car today, using ride-on-demand today, and using a robotaxi.

The cost of the daily commute could be reduced four-fold

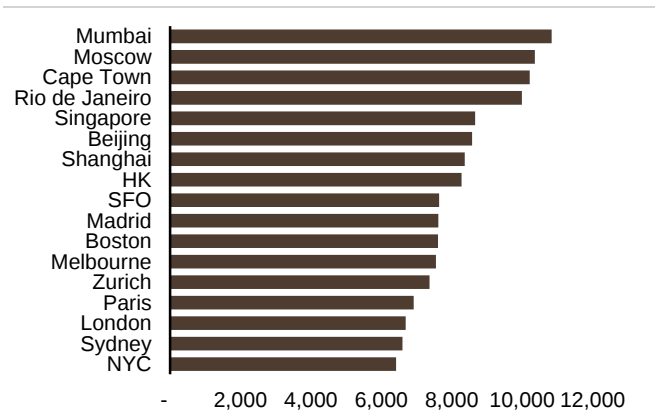
Figure 1: Cost of a daily commute (€)



Source: UBS estimates

Note: ICE stands for "internal combustion engine"; assuming 2 passengers per robotaxi and a daily commute of 40km

Figure 2: How many km can you buy in a robotaxi instead of using your private car?

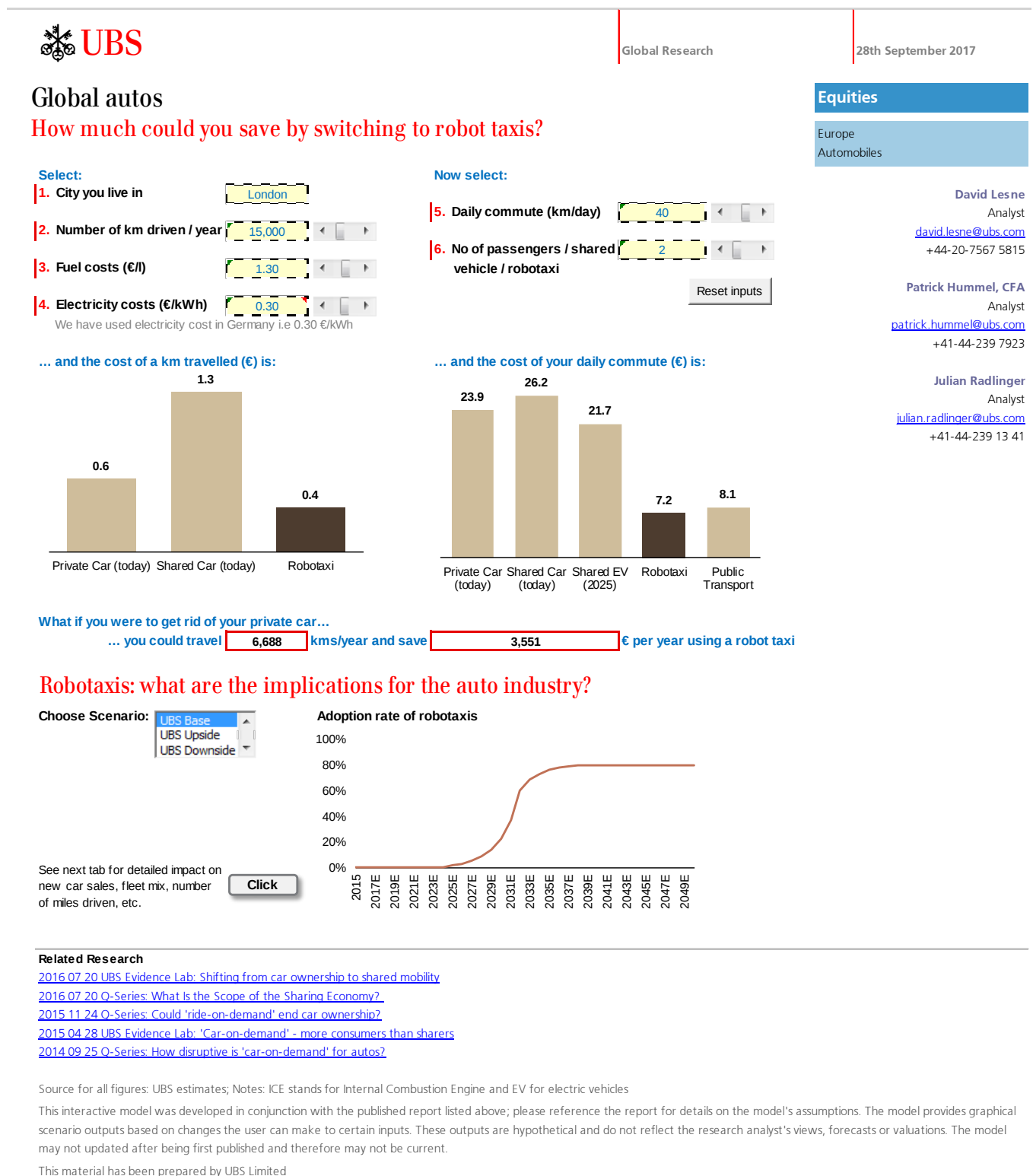


Source: UBS estimates

Note: Assuming the annual running costs of owning a private car are spent on robotaxis.

We have built two interactive proprietary models, which are available on UBS Neo (<https://neo.ubs.com/shared/d1m8mO00ft>).

Figure 3: UBS interactive model – cost of owning a car versus using robotaxis



Source: UBS estimates

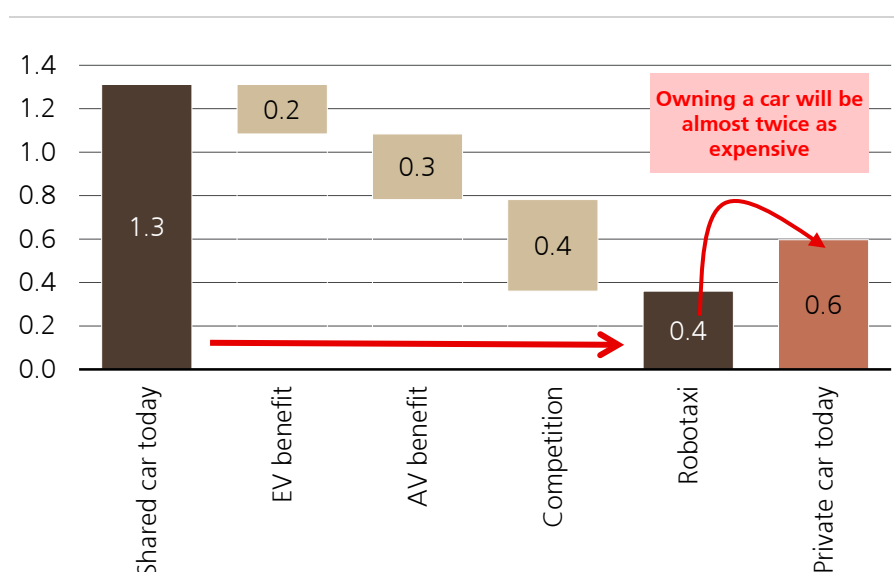
We have identified three key levers that will materially reduce the fee the shared mobility user is paying:

- **Optimised automated service platforms:** Robotaxis will require powerful algorithm to minimise customer wait time and optimise the utilisation rate of the fleet. In addition, the service infrastructure including two-way communication between the vehicle and the service centre will need to be in place.
- **The shift towards electric vehicles:** We have written extensively on the cost structure of an electric car and the relative cost of owning an EV versus an ICE (internal combustion engine). We conclude that the shift towards EV could reduce the fee charged by 15-20%.
- **The shift towards autonomous cars:** While we see fully autonomous vehicles as a few years off, we believe they will represent an important milestone for the auto industry in general, and shared mobility in particular. Today, about 60% of the total fee paid by the user of a ride-on-demand vehicle goes to the driver. Moving to a robotaxi will reduce the user's fee by about 25%.
- **Intensifying competition among shared mobility platforms:** We believe that the strong growth potential of shared mobility will attract more players. By removing the driver, the platform should in theory be able to capture 100% of the revenues generated by the trips. We think they will work as partners with OEMs. If we assume the platforms keep their profitability level similar to that generated by a shared vehicle (ICE) today, we see scope for prices to fall by €0.4/km or 30%.

Robotaxi clearly beats shared ICE vehicles

Driver's fee is 60% of the total fee paid by shared mobility users

Figure 4: Cost per km for the user as we shift towards robotaxis (€/km)



c80% reduction in the charge to users as we move towards robotaxis

Source: UBS estimates

Note: ICE stands for "internal combustion engine"; EV stands for "electric vehicles"; AV stands for "autonomous vehicles".

Are consumers ready to ride in robotaxis?

We update for the third time our UBS Evidence Lab consumer survey of 15,000 participants in five key markets. The main takeaways are: (1) ride-on-demand usage continues to increase globally; (2) public transport usage seems to be most at risk and most disrupted in the medium term; and (3) people are not ready to give up their car (yet).

We also found that acceptance of autonomous cars is already relatively high for a technology which has yet to become available and mainstream. Some 30% of respondents indicated that they would be interested in using an autonomous car, and 31% are undecided. In other words, almost two-thirds of respondents could be open to this new form of mobility.

We have used UBS Evidence Lab to analyse downloads of around 70 ride-on-demand apps globally. This is the fifth time in two years that we have run our app download analysis, and a unique time series is now emerging. UBS Evidence Lab data shows that: (1) there are almost five times more ride-on-demand app downloads than new cars sold globally each year; (2) about 80% of app downloads globally are in emerging markets, of which China is the largest (despite lower levels of car ownership); and (3) the app downloads growth momentum is slowing despite the strong popularity.

Impediments to making robotaxis a reality

Within the next few years, the technology will be available to make robotaxis a reality. In fact, most of the steps we have identified to reach mass adoption of robotaxis have already been achieved. The next key ones will be: (1) to dedicate speed and range-bound areas in cities (Singapore will start as early as next year); (2) to redesign the interior of the vehicles to accommodate passengers and optimize their experience; and (3) to adapt the city infrastructure to this new form of mobility.

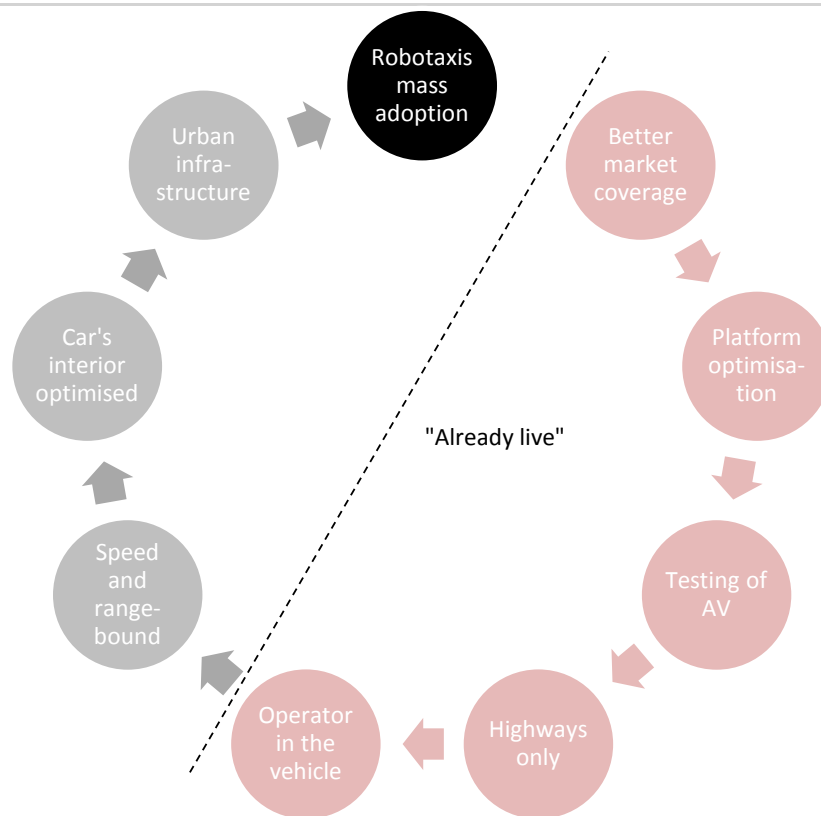
Ride-on-demand usage continues to increase

Consumers are already "open" to using autonomous vehicles

There are almost five times more ride-on-demand app downloads than new cars sold globally each year

The technology will be available within the next few years

Figure 5: Roadmap towards mass adoption of robotaxis



Source: UBS

We have listed below the key hurdles and challenges to address:

- **Supply during "rush hours":** One key hurdle for the mass adoption of robotaxis will be rush/peak hours. Could this form of mobility handle strong demand waves during short periods of time during the day? We see several potentially mitigating factors:
 - *Change in consumer behavior:* As cars will become an extension of someone's home or office, we think behavior and individuals' schedules could change and adapt, leading to a smoother demand pattern during the day. There will also be highly sophisticated communication networks, with 3D vision, AI and robots, meaning the need to commute might be reduced.
 - *Effective passenger occupancy/sharing:* A study done by the HubCab I MIT Senseable City Lab showed that about 90% of the taxi trips in NYC could be shared if each user was willing to lengthen their trip by an average of five minutes, reducing the total distance travelled by 40%. They found similar results in other large cities. However, it is not clear how far this is true of mid-sized or smaller cities (as there is limited data). Nor is it yet clear how willing passengers will be to share rides.
 - *Smart traffic lights:* Connected cars can enable significant improvements in traffic flow. MIT used travel data to show that "smart" traffic lights (enabling car traffic based on speed and cross-traffic) could manage twice as much traffic with the same amount of vehicles, almost eliminate wait times, reduce congestion at inter-sections, reduce travel times, and lower emissions.

Robotaxis become an extension of your home or office

Close to 100% of travel can be shared if passengers are willing to wait up to five minutes

Better traffic flow

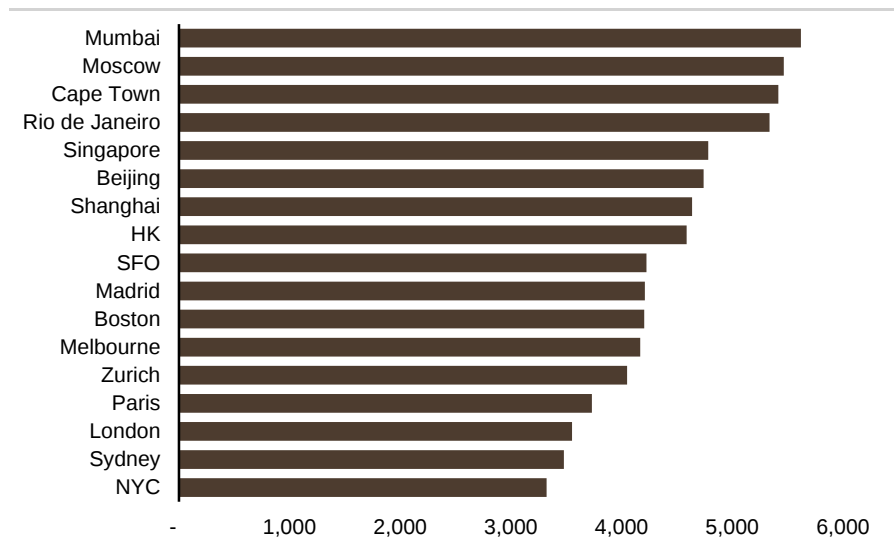
For more details, please refer to our report [MIT Future of Infrastructure Highlights Big Data](#), published on 15 September.

- Last year, we hosted a call with the secretary-general of the International Transport Forum (ITF). The ITF had built a model analysing the impact of replacing all cars and bus trips in a city with fleet of shared on-demand vehicles. The conclusions were that: (1) only 3% of today's fleet would be required; (2) congestion would disappear; (3) the total number of required parking spaces would be reduced by 95%; and (4) CO2 emissions would be reduced by a third.
- **Liability/insurance:** Who is responsible in the case of an accident – The passenger, the platform, or the OEM/fleet manager? We think the OEM/platform is likely to take on the risk, and reflect this in the fee charged to users.
- **Taxi industry/labour regulations:** What happens to the traditional taxi drivers? There may need to be publicly funded re-training initiatives to help taxi drivers find new employment. Nor should one underestimate the powerful taxi lobbies, as evidenced by Transport for London deciding not to renew Uber's licence at the end of September. There will always be a tussle between incumbents and disruptors; even if the technology is ready, some elements of society may not be.
- **Privacy/cybersecurity:** Users are likely to spend on average almost two hours per day using mobility platforms. The platform will gather huge amounts of data on its customers' habits and lifestyle. Separately, what happens if a hacker takes over control of the vehicle? Initially, we could imagine that an operator will remotely control several cars to make sure everything goes smoothly. In the long run, there could be an emergency button that will stop the car.

What are the key benefits that robotaxis bring?

We think the benefits to society will overcome the challenges and will facilitate the transition. Firstly, our UBS Evidence Lab consumer survey shows there is already a fairly high level of acceptance of this new form of mobility. Secondly, we estimate that households could save €5,000/year for the same number of kilometres driven through switching to robotaxis. And the OEMs and platforms would benefit from a much larger addressable market (people without a driving licence, low-income households, etc.). Finally, there will be a significant reduction in the need for parking spaces, which will free up urban space. Noise and pollution levels in cities should also drop materially.

Figure 6: How much could you save per year by switching from private car to robotaxis? (€)



Source: UBS

What are the implications for the auto and other industries?

How could auto OEMs reinvent themselves?

Most people believe that the transition towards the "car of the future" will be hugely negative for OEMs. To some extent, those worries are already reflected in the OEM's valuations, as they currently trade >20% below their historical mid-cycle multiples. In the current model as we know it today, OEMs barely return their cost of capital through the cycle. Our analysis suggests that OEMs have the opportunity to expand their roles into new areas, which could slightly improve their future returns through the cycle. More importantly, a more stable earnings stream through services/subscriptions could trade on higher multiples than earnings from selling the hardware today. Managing the transition could be a challenge: OEMs are "supertankers", and changing direction (organizational, societal, financial) can be an enormous task for management teams.

In this new paradigm, we have identified four revenue areas in which OEMs could expand:

- **Fleet management:** The platform has no interest in producing the cars or managing the fleet, as it requires too much capital. It will therefore seek partnerships with either carmakers or car rental companies and pay a fee for the management of the fleet. As producers of the vehicles, OEMs are likely to be well positioned to win this business. The required fee will have to be high enough to guarantee both an attractive profit margin and returns for the OEM. The OEMs' fincos are already heavily involved in fleet management today, and are likely to move from leasing/renting classic ICE vehicles to owning fleets of robotaxis.
- **Physical asset management:** The OEM will finance part of the vehicle's production cost by bringing in external investors. The capital will be structured into a pool, which will receive a "guaranteed" annual yield and also pay an annual asset management fee. This will be similar to the structures used for

Less cyclical revenue streams and slightly higher returns

From leasing ICE cars... to managing fleets of robotaxis

"Buy-to let" business model

asset-backed securities. The cost of risk should be very low, given: (1) the scope to diversify the portfolio (by OEM, platform, geography or vehicle type); and (2) the relatively low value of the initial investment and the collateral.

- **Teleco operator:** The traditional telco operators will likely be key enablers, as they will develop the infrastructure required for autonomous vehicles to work. The OEM will compensate them by increasing the fee charged to the user. We see two potential revenue streams that could be shared between the OEM and the platform: (1) a monthly subscription fee, enabling user loyalty to be strengthened; and (2) reliable and stable access to data. We estimate that each user will spend about 40 hours per month in the car, equivalent to 27GB of data consumed, compared to an average of 2GB/month today.
- **Advertising/media:** The time we spend in cars will structurally increase in the future, for two key reasons: (1) the shift from public transport towards robotaxis; and (2) the lower cost of using a robotaxi versus owning a car. We think the OEM and the platform will share the advertising revenues, which will come from: (1) adverts inside the vehicle; (2) adverts on the vehicle (digital paint); and (3) adverts on the road. We estimate that the yearly revenue captured by the OEM alone could be almost €400-500 per robotaxi.

Passengers will consume 15x more data in a robotaxi than today

Three streams: ads inside, outside and on the vehicle

We see the shared mobility platforms and the OEMs working together as partners. One simple reason for that is the fact that the platforms have no interest in producing cars and would rather outsource the ownership of the cars in order to keep the business model as asset-light as possible. The platforms will be responsible for connecting supply with demand and boosting the vehicle's utilisation rate. OEMs will be in charge of producing the vehicle and designing the interior of the car in order to optimise the user's experience.

Platform and OEMs working together as partners

What are the implications for the auto industry?

We have modelled three scenarios of adoption for robotaxis (see [our interactive model available on UBS Neo](#)). In our UBS base case, we assume the adoption rate of robotaxis will reach 80% of the urban population by 2040, with the sharp increase of the S-curve happening around 2030. The fully autonomous vehicle technology will be developed and available earlier than that, but it will take some time before cities and regulators feel comfortable letting robotaxis on the road. We see the following impacts for the auto industry:

Our base case assumes 80% of urban population is using robotaxis in 2040

- **New car sales:** We estimate that there could be 34m robotaxis sold per year on average between 2016 and 2050. In the long term, we see new car sales running about 10% lower in a "robotaxi world" than otherwise. However, in the medium term, new car sales are likely to be slightly supported until 2025 and then drop off as the adoption rate of robotaxis accelerates.
- **Car penetration:** We estimate that car penetration will fall from 250 vehicles per 1,000 people today to about 50 in 2050 in an urban world.
- **Faster EV adoption:** We forecast 14m electric cars will be sold in 2025, of which 14% will be robotaxis. In our upside case, we would have to raise our EV forecasts for 2025, since all the EVs sold in 2025 would be robotaxis. All in all, the shift towards robotaxi means faster adoption of robotaxis.

Global new car sales 10% lower in a "robotaxi" world

In our upside case, we would need to raise our EV forecasts

- **Size of the car parc.** We estimate the fleet size will shrink by 50% by 2050. The urban world could be completely reshaped as, for instance, parking spaces would become irrelevant.
- **Number of kilometres driven.** A robotaxi will drive >5x more kilometres per year. We estimate that the total number of kilometres driven globally will increase by 60% and that the number of kilometres driven per car should increase from 15,000/year to about 80,000/year.

Urban infrastructure could be redesigned

Sharp increase in the number of kilometres driven

Figure 7: Robot adoption – scenario analysis

	Downside	Base	Upside
Increase (reduction) in new car sales globally (2050)	4%	-10%	-8%
Increase (reduction) in the urban fleet (vs today)	18%	-48%	-62%
Weight of fleet buyers (%-pts) (vs today)	8%	27%	32%
Utilisation rate of robot taxis (%)	31 %	57%	57%
Number of kilometers driven/year (x) (vs today)	0.7x	0.6x	0.6x
Number of electric cars sold (x) (vs 2025)	4.8	4.6	5.2
Robot taxi as % UBS EV forecasts (2025)	0%	14%	153%
ASP increase (vs today)	9%	11 %	12%
Number of robot taxis on the road (m) (2050)	204	196	220
Average number of robot taxis produced per year (m)	28	34	46

Source: UBS

Key investment implications

We have screened our global OEM coverage for what we believe will be key success factors (Figure 8).

- **EV potential:** Skew to OEMs with dedicated battery electric vehicle (BEV) platforms (which we expect to pay off medium term through scale effects). Developing a dedicated EV platform will help in optimising the space inside the vehicle, improving the performance of the car and delivering a better user experience for each ride.
- **Focus on autonomous vehicles:** "First mover" vs "fast follower" strategy.
- **Focus on shared mobility/partnership with a platform:** Some OEMs are being more pro-active in terms of existing car-sharing offerings and taking equity stakes in the shared mobility platforms that help to connect supply and demand. This relationship should provide a competitive edge for those OEMs and protect their future production capacity. At the same time, the platforms will make sure there is enough competition amongst OEMs.
- **Finco ownership:** Fleet management experience.

We see the following factors as key for the suppliers to make a successful transition to shared mobility (Figure 9):

- **Limited exposure to the "legacy" combustion powertrain business.** All the legacy ICE products are likely to become irrelevant.
- **Partnership strategy in ADAS (advanced driver-assistance systems).** We favour the "partnership" strategy as opposed to the "vertical integration" strategy. Today, there is not just one single "winning" technology that enables autonomous vehicle. Suppliers are investing large amounts in R&D for some solutions, which might never generate a return.

- **Strong balance sheet and cash generation**, mainly to fund the transformation process.

Figure 8: OEMs – impact of shared mobility at a glance

	EV potential	Investment focus on		Partnership w. a platform	Finco ownership
		AV	Shared mobility		
Tesla	Very high	Very high	High	No	No
Daimler	Very high	High	High	No	Yes
JLR	Very high	Medium	Medium	No	No
Volvo (Geely)	Very high	High	Low	No	No
BMW	Very high	High	High	No	Yes
VW	High	High	High	Yes	Yes
Renault	High	Low	Medium	No	Yes
Nissan	High	High	Medium	No	Yes
Toyota	High	High	High	Yes	Yes
PSA	High	Low	Low	No	No
Ford	High	High	High	No	Yes
GM	High	High	High	Yes	Yes
Mazda	Medium	Medium	Low	No	No
Honda	Low	High	Medium	No	Yes
FCA	Low	Low	Medium	No	No
Subaru	Low	Medium	Low	No	No
Suzuki	Low	Low	Low	No	No

Source: UBS

Figure 9: Suppliers – impact of shared mobility at a glance

	Share of revenues related to		Balance sh. strength*	FCF generation**
	ICE Powertrain	ADAS / autonomous vehicles		
Autoliv	0%	7%	0.1x	4.4%
Continental	19%	23%	0.3x	5.9%
Faurecia	40%	31%	0.2x	0.3%
GKN	41%	0%	0.3x	8.1%
Gestamp	0%	0%	1.8x	0.3%
Hella	1%	4%	0.3x	3.5%
Michelin	0%	0%	0.2x	8.4%
Nokian	0%	0%	-0.7x	3.4%
Schaeffler	50%	0%	1.1x	7.9%
Valeo	25%	20%	0.6x	4.0%
BWA	62%		1.0x	6.1%
Delphi	35%		1.0x	6.7%
Lear	0%		0.3x	10.1%
Magna	15%		0.6x	9.2%
Tenneco	70%		1.2x	9.7%
Visteon	0%		-1.2x	3.6%
Aisin Seiki	56%	1%	-0.5x	5.5%
Denso	35%	3%	-1.0x	4.1%

Source: UBS

OEMs will need to reinvent their business model and expand their activities to new areas, such as fleet management, asset management, telco and media.

Suppliers with high exposure to ICE legacy products will have to manage the transition and diversify their offering. Suppliers with exposure to the key auto megatrends are well positioned to benefit. However, the landscape is likely to become more competitive, with non-traditional tier one players gaining market share. The decline in aftermarket revenues will also be a headwind.

Tire makers are set to benefit from the increased number of kilometres driven. We estimate that the annual cost for tires is about 5-6x higher than in a private car today. However, the higher weight of fleet buyers should put pressure on pricing, but this could be offset by improving product mix (i.e. more durable tires).

Shared mobility will have a strong fundamental impact on many sectors. UBS global sector teams have contributed their analysis. Further, they have highlighted the stocks most positively or negatively exposed.

Figure 10: Sector map – impact of shared mobility at a glance

Shared mobility Impact on ...	Revenue growth	EBIT margin	ROIC	Valuation	Shared mobility Impact on ...	Revenue growth	EBIT margin	ROIC	Valuation
Auto OEMs					Chemicals				
Auto suppliers					Capital goods				
Battery producers					Oil				
Semi-conductors					Steel				
Utilities									
Tech									

Source: UBS estimates

Figure 11: Stock positively and negatively impacted by the theme

Positively impacted			Negatively impacted		
	Rating	PT (lcl)		Rating	PT (lcl)
Daimler	Buy	85	PSA	Neutral	18
VW	Buy	180	FCA	Neutral	13.4
Michelin	Buy	129	Schaeffler	Sell	10
Valeo	Buy	82	Autoliv	Sell	87
Conti	Buy	230	United Utilities	Sell	825
LG Chem	Buy	375,000	Severn Trent	Sell	2090
Samsung SDI	Buy	240,000	Seagate	Sell	28
Infineon	Buy	21	Johnson Matthey	Sell	2650
Texas Instruments	Buy	93	EMS-Chemie	Sell	450
Fortum	Buy	16.1	SKF	Sell	140
EDF	Neutral	8.6	Sandvik	Sell	110
Flex	Buy	18	Admiral	Neutral	2050
Umicore	Buy	75	Allstate	Neutral	93
Siemens	Buy	131			
Allianz	Buy	200			
ArcelorMittal	Neutral	21.5			

Source: UBS estimates

How do robotaxis work?

The passenger uses its smartphone to register its location and its destination. The passenger will be guided to a pick-up point (less than 3 min-walk), which will allow to optimise the route and the travel time. The robotaxis arrives to pick-up the

passenger, which may or may not share the ride with other people. During the trip, the passengers can easily be connected live with a central operator, which can help in case of technical issue or an emergency. We can imagine that the interior of the robotaxi will be designed in order to accommodate a private and personalised space for each passenger. In effect, the robotaxi could become an extension of your home or living room. The passenger is then left at a drop-off point, which is located at a short walking distance to its destination.

We present below some illustrations on how a robotaxi could look like:

Figure 12: Conti has developed CUBE ...



Source: Conti

Figure 13: ... with its partner EasyMile



Source: Conti

Riding towards free transport

We undertook a deep-dive analysis of how the cost per kilometre could evolve as we move towards "electric autonomous shared" vehicles, or robotaxis. In this new world, the cost of running the car will decline sharply.

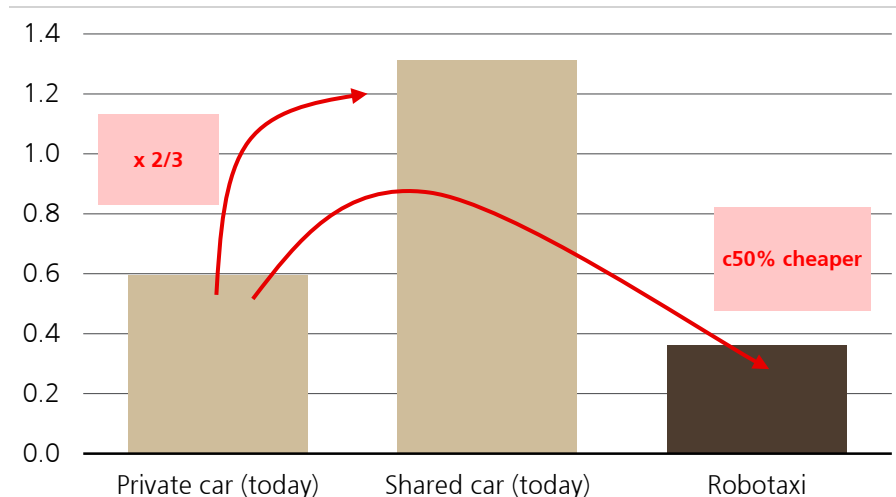
Assuming the platforms fully reflect the benefits to end users, we estimate that the cost per kilometre for the passenger in a robotaxi could be half that of owning a private car (assuming one passenger per vehicle). In fact, the fee charged by the platforms for trips could reduce by almost 80%, compared to today. Consequently, the cost of the daily commute to work should fall from €24 per day in a private car to €7.2 per day in a robotaxi (assuming 2 passengers per vehicle). Sharing the robotaxi with other passengers will further decrease the cost of a ride. Getting rid of their private car will enable the shared mobility user to "purchase" about 10,000km per year in a robotaxi.

The cost of the daily commute to work will fall from €24 per day to €7.2 per day

Key outcomes - Riding towards free transport...

The "car of the future" will most likely be electric, autonomous and shared. In this section, we try to quantify by how much the cost per kilometre could be reduced as we shift towards electric, autonomous and shared vehicles, or robotaxis. We assume that all the benefits are passed through to the passengers. We conclude that the cost of using shared mobility today is about 2-3x higher than the cost of owning an ICE ("Internal Combustion Engine") car (Figure 14). However, we estimate the fee charged to users could drop by 80% in a robotaxi and that the cost will be half that of owning a private car.

Figure 14: Owning a car vs using a robotaxi – fee for the user (€/km)



The cost of using a robotaxi will be half that of owning a car

Source: UBS estimates

Note: Assuming one passenger per robotaxi.

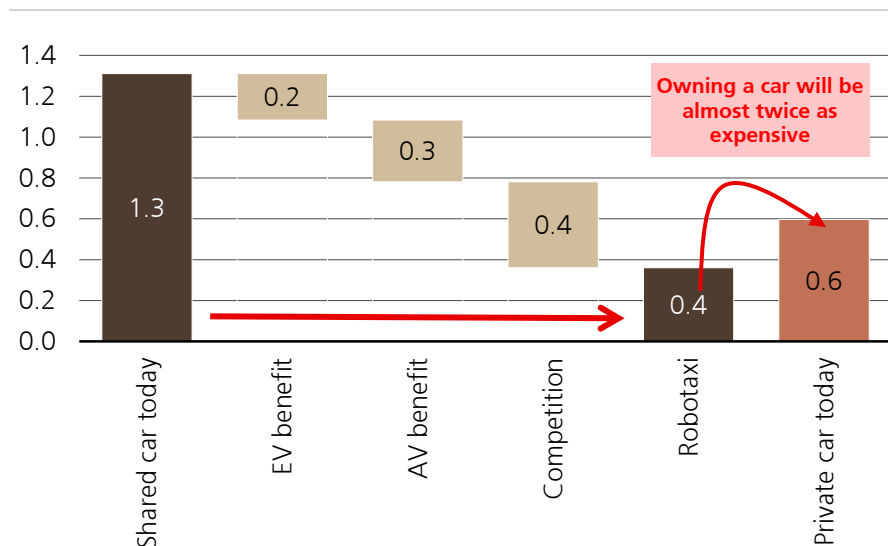
We have identified three key levers that should materially reduce the fee paid by the shared mobility user:

- **The shift towards electric vehicles:** We have written extensively on the cost structure of an electric car and the relative cost of owning an EV versus an ICE. Our teardown of the Chevy Bolt has given us unique insight. We conclude that the shift towards EV could reduce the fee charged by c15%.
- **The shift towards autonomous cars:** We have also written extensively on autonomous vehicles, auto tech and connected vehicles. While we see fully autonomous vehicles as at least five years off, we believe they will represent an important milestone for the auto industry in general, and shared mobility in particular. Today, about 60% of the total fee paid by the user of a ride-on-demand vehicle goes to the driver. Moving to a robotaxi will reduce the user's fee by about 25%.
- **Intensifying competition among shared mobility platforms:** We believe that the strong growth potential of shared mobility will attract more players. For instance, our app download analysis shows the emergence of regional players. By removing the driver, the platforms should in theory be able to capture 100% of the revenues generated by the trips. We think they will work as partners with OEMs. If we assume the platforms keep their profitability level similar to that generated in an ICE vehicle today, we see scope for prices to fall by €0.4/km or 30%.

Robotaxi clearly beats shared ICE

The driver's fee is 60% of the total fee paid by shared mobility users

Figure 15: Cost per km for the user as we shift towards robotaxis (€/km)



c80% reduction in the user fee as we move towards robotaxis

Source: UBS estimates

Note: ICE stands for "internal combustion engine"; EV stands for "electric vehicles"; AV stands for "autonomous vehicles".

We present below our key underlying assumptions.

Key assumptions

We are painting one scenario for a somewhat hypothetical average city: how the future will look like for Beijing vs San Francisco vs London vs Berlin or Emerging vs Developed markets is impossible to assess at this stage. In addition, a lot of tech developments could move the results in multiple ways. So with all those caveats, we believe our framework should enable to engage with investors and our interactive models should investors assess the range of possible outcomes.

- **Purchase price:** We use the same assumptions as in our teardown of the Chevy Bolt. We assume the price of an autonomous vehicle will be about €5,000 higher in the long run to reflect the cost of all the sensors required (cameras, radars, lidar, etc.). For more details, please refer to our [Q-Series: New era for auto tech - who wins and who loses?](#). This is also consistent with Valeo's estimated content uplift required to reach Level 5 or full automation.
- **Number of trips per day:** As per New York, San Francisco and Singapore transport authorities, the number of daily trips per taxi is currently ranging between 20 and 30. In our model, we assume this number increases to 40 daily trips in a "robotaxi" world. The key reasons for this are: (1) strong growth in demand (see our UBS Evidence Lab app downloads analysis); (2) the shift from public transport, given the lower cost of a trip; and (3) optimisation in the system. We also note that an MIT study estimated that the NYC taxi fleet could be reduced by 40%, without sharing, if optimized data were available, reducing driver wait time, traffic and emissions.
- **Number of kilometres per trip:** New York City transport authorities estimated that the average length of a taxi trip is about 4km. In our "robotaxi" scenario, we assume the number of kilometres per trip doubles, driven by a blend of short-distance trips of 4km and long-distance trips of 18km (similar to the average daily commute distance in the UK today, based on UK Census figures). Given the lower commuting cost, consumers might decide to live a bit further from their work.
- **Average idle time:** We reduce the average idle time from 10 to 5 minutes, for the following reasons: (1) powerful algorithms able to connect demand with supply more efficiently; and (2) robotaxis will operate like dynamic bus lanes that can efficiently adjust to where the demand is. MIT analyzed NYC taxi data to better understand how travel can be optimized. They found that close to 100% of trips can be shared if passengers are willing to wait up to five minutes. They found similar results in other large cities.

Figure 16: Key underlying assumptions

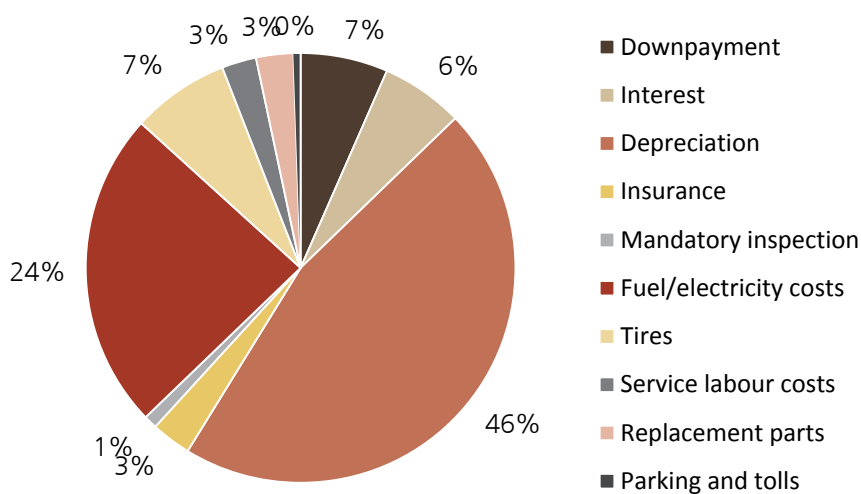
	Private car	Shared car	Robot taxi	Comments
Horizon	Today	Today	2030	
Financing				
Purchase price (€)	29,475	29,475	34,769	- Assuming €5,000 additional content vs BEV (sensors, interior experience)
Downpayment (%)	10%	10%	10%	
Interest rate (%)	3.5%	3.5%	3.5%	
Residual value (%)	50%	50%	20%	
Time of ownership (years)	3	3	3	
Fuel/electricity consumption				
Fuel (€ per liter) / (€ per kWh)	1.30	1.30	0.30	- Using the average cost in Germany
Utilisation				
Number of working days	250	250	250	
Trips per day	3	30	40	
Number of km/trip	20	4	8	- Better market coverage, expanding towards suburbs
Average speed km/h	31	31	31	
Average idle time in between trips	0	10	5	- Demand more efficiently connected to supply
Utilization (h per day)	1.9	9.0	13.7	
Utilisation rate (%)	8%	38%	57%	
Annual mileage (km pa)	15,000	30,000	80,000	
Running costs				
Tires (€ cents/km)	1.33	1.33	1.62	- Higher cost due to higher curb weight in an EV
Service labour costs (€ cents/km)	1.43	1.43	0.57	- Maintenance costs 60% lower in an EV
Replacement parts (€ cents/km)	1.54	1.54	0.62	- Maintenance costs 60% lower in an EV
Parking and tolls (€ cents/km)	1.37	1.37	0.64	- Related to the higher utilisation rate
Insurance (€/year)	529	529	529	
Annual inspection (€/year)	175	175	175	
Base fare (€)				
City		London	London	- See our interactive model for other cities
Base (per trip)		2.8	1.6	
Duration fare (per min)		0.2	0.1	
Distance fare (per km)		0.9	0.5	
Min fare		5.5	3.3	

Source: UBS estimates

For more details on the underlying assumptions, please refer to Figure 98 in the Appendix.

In Figure 17, we show the cost structure of a robotaxi. Depreciation and electricity costs represent almost two-thirds of the total cost.

Figure 17: Cost structure of a robotaxi (assuming the platform manages the fleet)

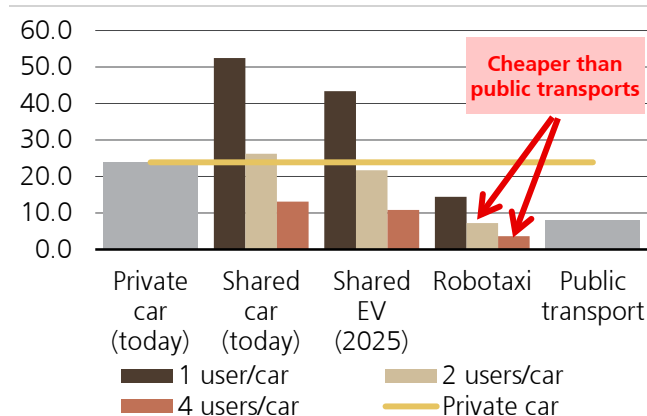


Source: UBS estimates

Our analysis is based on only one passenger using the robotaxi. As the interior is designed to accommodate several users, we believe robotaxis could rapidly compete with public transport. We estimate that the cost of the daily commute could fall down to €3.6 (in a scenario with 4 passengers per vehicle) (Figure 18).

Robotaxi could rapidly compete with public transport

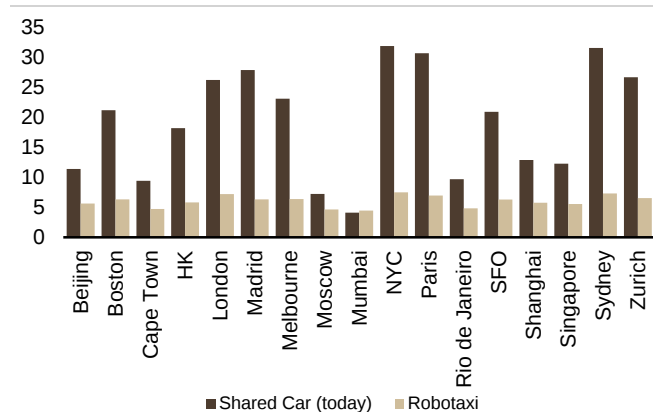
Figure 18: Daily commute costs as several passengers share the overall fee (€) (20km driven per leg; 40km driven per day)



Source: UBS estimates

Note: The cost for private ICE stays the same, as the private car owner is unlikely to split the cost by the number of passengers in the car

Figure 19: Cost of a daily commute comparison



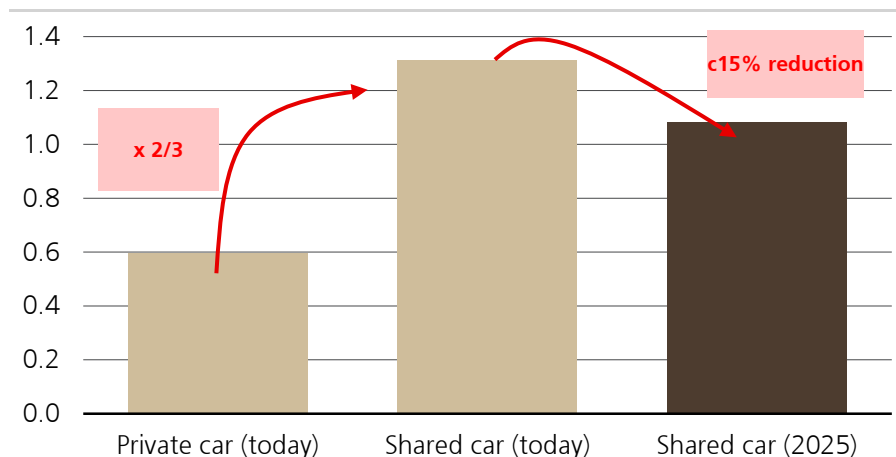
Source: UBS estimates

Note: assuming 2 passengers per robotaxi and a daily commute of 40km

The economic levers between now and then

Lever 1: Shift towards electric cars

Figure 20: Shift towards EV – potential to reduce the cost per km (€/km)



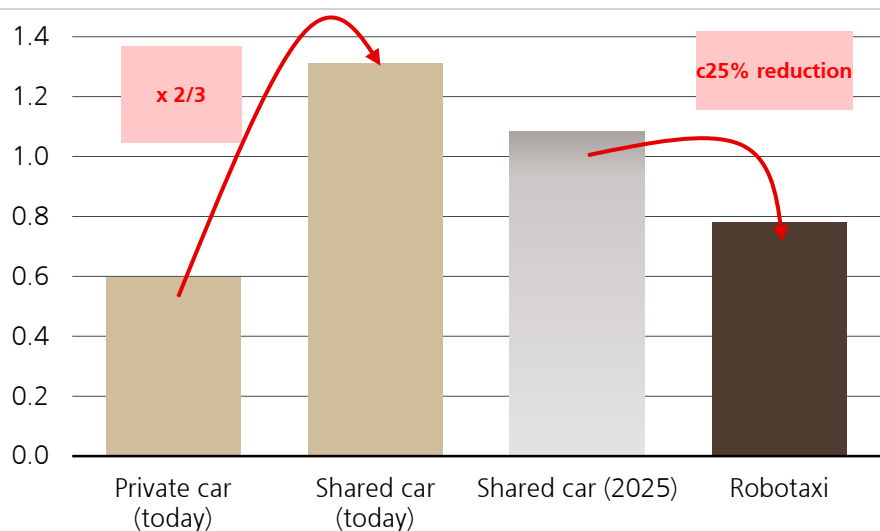
Source: UBS estimates

Lever 2: Shift towards autonomous vehicles

We estimate that the shift towards robotaxis should help reduce the user's fee by about 30 cents/km, or about 25%. Assuming the robotaxi will also be electric, the cost of a km will reach about 80 cents – almost at parity with a private car.

The robotaxi fee will be at parity with the cost of owning a private car

Figure 21: Moving towards robotaxis will reduce the user's fee by another 30% versus a shared EV (€/km)



Source: UBS estimates

Note: We assume one passenger per robotaxi

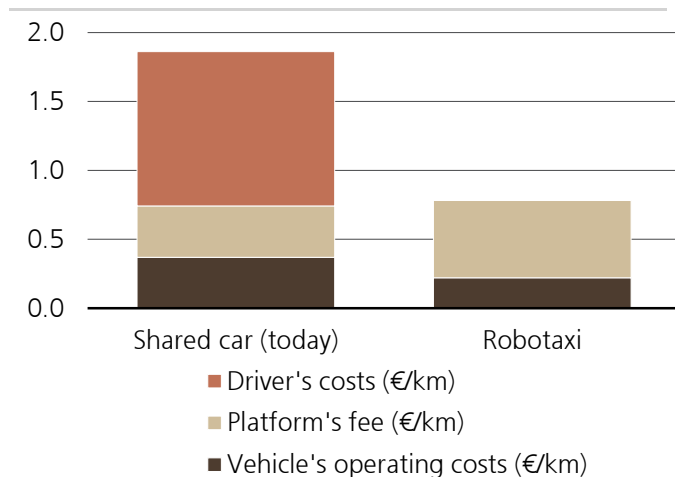
There are three key reasons for the lower fee in a robotaxi, compared to a shared ICE or a shared EV:

- **No driver.** We have broken down the user's fee in a shared ICE today (Figure 22). We estimate that the cost of the driver alone represents almost €1/km, or about 60% of the total fee. The platform's fee (Uber, Gett, etc.) represents about 30 cents. In a robotaxi, there is no longer a driver. The vehicle's operating costs are reduced since the powertrain of a robotaxi will most likely be electric (see previous section). The operator's fee is further boosted as the utilisation rate of the vehicle increases (see paragraph below).
- **Higher utilisation rate (and lower parking costs).** The autonomous car will be an important milestone for shared mobility. One of the main hurdles to optimising the utilisation rate of a vehicle is to locate demand and adjust supply accordingly. One way to mitigate this issue could be a self-driving connected car. We estimate that autonomous vehicles could boost the utilisation rate of cars from 8% for an owned ICE car today to 57% for a robotaxi (Figure 23). Our analysis also reflects the lower related parking costs.

The cost of the driver represents c60% of the fee charged to the shared mobility users

Robotaxi will be used 8x more than private cars

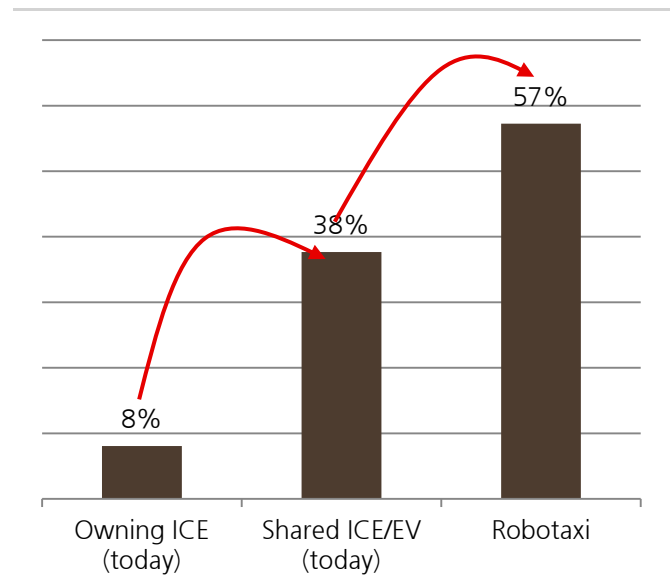
Figure 22: Structure of the user's fee – shared ICE vs robotaxi



Source: UBS estimates

Note: For the robotaxi, we assume a 25% fee charged on top of the underlying running costs.

Figure 23: Vehicle utilisation rate



Source: UBS estimates

- **Lower maintenance costs.** We think the connected car will revolutionize the sales and marketing process and improve the dealer servicing experience. With a modem, the automaker/operator can receive output from the 60 to 100 sensors on a vehicle. This enables data to be sent out including diagnostics data, location data, as well as data to be delivered to the car like software updates, updated traffic data, and ads. For more details, please refer to our [Q-Series: Global auto & tech - How will big data revolutionize the auto industry?](#)

We assume the price of an autonomous vehicle will be about €5,000 higher in the long run to reflect the cost of all the sensors required (cameras, radars, lidar, etc.). For more details, please refer to our [Q-Series: New era for auto tech - who wins and who loses?](#). This is also consistent with Valeo's estimated content uplift required to reach Level 5 or full automation.

Our expert partner in the teardown of the Chevy Bolt, Munro, expects the cost of the front camera, which currently comes in at ~\$120, to decrease by 2025, mainly driven by increasing competition in the segment. In the Chevy Bolt, six cameras were found overall, including two front-facing cameras (grille and windshield), two in the rear-view mirrors, and two at the rear of the vehicle. As far as ultrasonic sensors are concerned, Munro expects little pressure on prices beyond increased volumes driving incremental savings. All in all, three ultrasonic sensors were found in the Bolt, all of which were located in the rear of the vehicle, and which are estimated to cost ~\$6-10 each.

What did our teardown of the Chevy Bolt show?

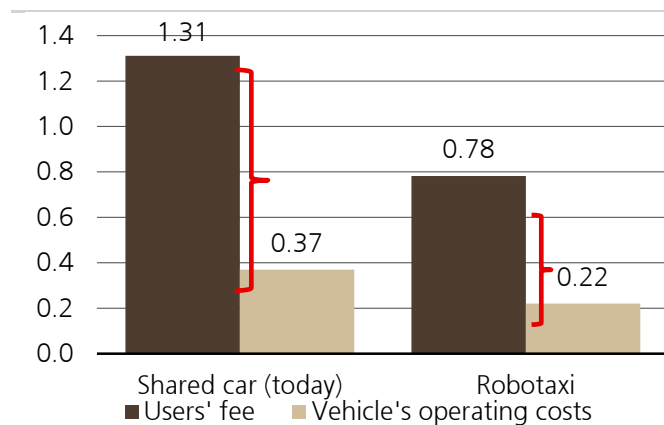
Lever 3: Intensifying competition among platforms

Sharp uplift to the platform's gross profit initially

Using current prices for UberX in London, we estimate that the platforms charge the passenger a fee per km, which is about 4x the cost of running the car (Figure 24), which is covered today by the driver. As the driver is no longer needed in a robotaxi, we assume (for now) that the platform will cover those costs. At the

same time, the operator will be able to capture 100% of the revenues, which relate to a utilisation rate double that for a shared ICE car today. All in all, the platform's profit pool (in €) could be multiplied by a factor of five as we move towards robotaxis (Figure 25).

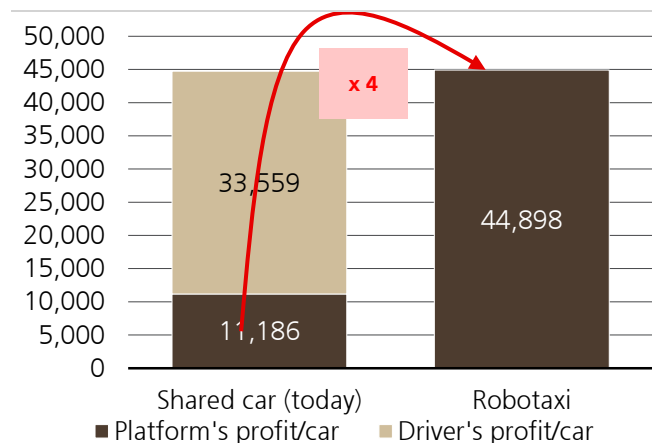
Figure 24: Users' fee versus vehicle operating costs (€/km)



Source: UBS estimates

Note: Assuming one passenger per vehicle and excluding the cost of the driver in 'today' scenario. For other underlying assumptions, please refer to Figure 16.

Figure 25: Gross annual profit split – operator vs driver



Source: UBS estimates

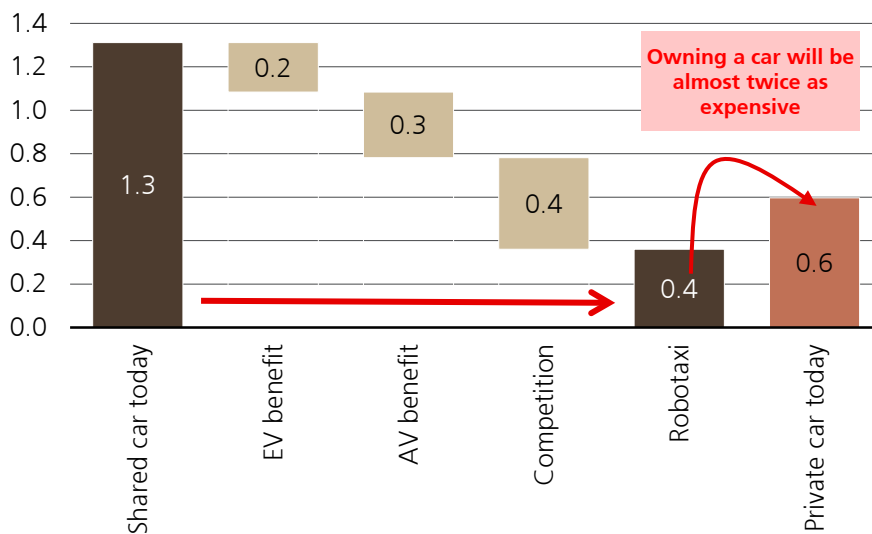
Lower barriers to entry once the vehicle becomes autonomous

Today, ride-on-demand benefits from the network effect: more drivers attract more users and vice-versa. Once the vehicle is autonomous, the barriers to entry are likely to reduce materially. This will most likely attract new entrants, create more competition and result in lower prices.

We try to assess how far pricing could fall without the platform's profitability falling from the level it is generating today for a shared ICE. We see plenty of scope for the shared mobility platforms to reduce prices while keeping a very good level of profitability. In addition, we believe the platforms could find new revenue streams, which should help offset lower prices (see next section). All in all, we estimate that the user's fee could be further reduced by 40 cents/km, implying that the cost of using a robotaxi will reach 40 cents/km, or half the cost of owning a private car today.

How much lower could prices go?

Figure 26: Key levers for reducing the user's fee (€/km)



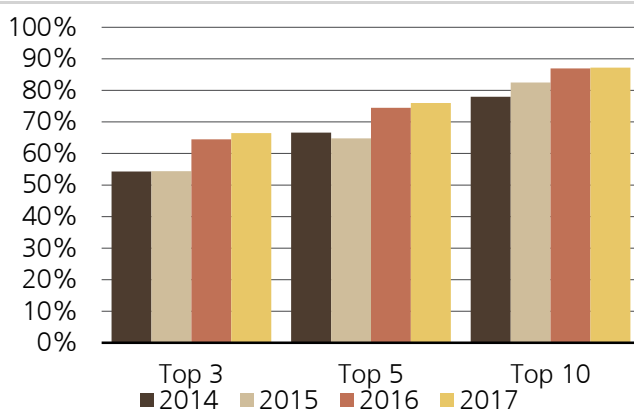
Source: UBS

In the near term, high level of concentration boosts pricing power

The ride-on-demand industry benefits from a high level of concentration, which has increased further over the past four years. The top three players now control 66% of the market, up from 54% in 2014 (as a percentage of app downloads). We have calculated the Herfindahl-Hirschman Index (HHI) for ride-on-demand services (methodology below) to gauge the concentration level. The HHI increased from 1,500 in 2014 and seems to be stabilising now around 2,700. In the HHI methodology, a value above 2,500 reflects a highly concentrated industry.

Ride-on-demand benefits from a high level of concentration

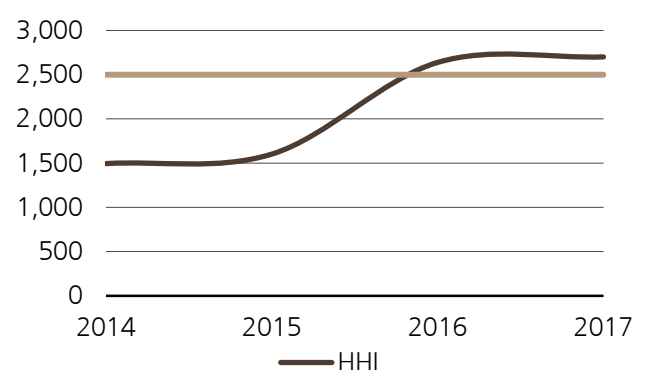
Figure 27: Performance of leading ride-on-demand platforms



Source: UBS Evidence Lab, Sensor Tower

Note: Based on the share of global downloads.

Figure 28: HHI concentration index for ride-on-demand services



Source: UBS Evidence Lab, Sensor Tower

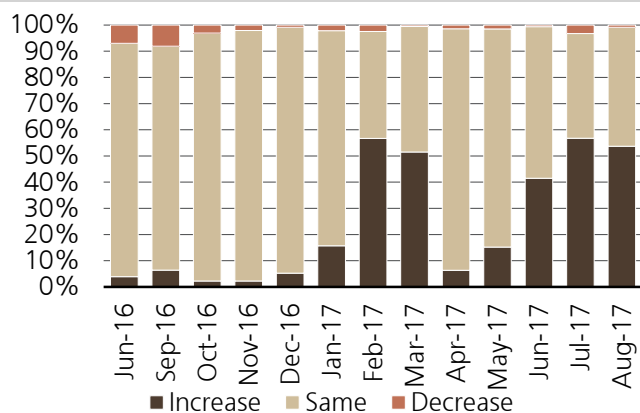
Note: Based on the share of global downloads.

Let's now connect this high level of concentration with pricing trends. For this report, the UBS Evidence Lab Price Intelligence team collected Uber prices on a weekly basis for ~600 markets across ~70 countries since April 2016. From this data set, we are able to track new market launches for UberX, as well as relative prices across markets and price changes. Figure 29 shows that Uber has increased

Very few markets have experienced a decline in prices

prices in 28% of markets and decreased prices in only 3% of markets, on average. In Figure 30, we show the top 20 markets (out of the 600 we track) where prices have increased and decreased the most.

Figure 29: UberX pricing trends globally since June 2016



Source: UBS Evidence Lab

Figure 30: Top 20 markets with highest change in price

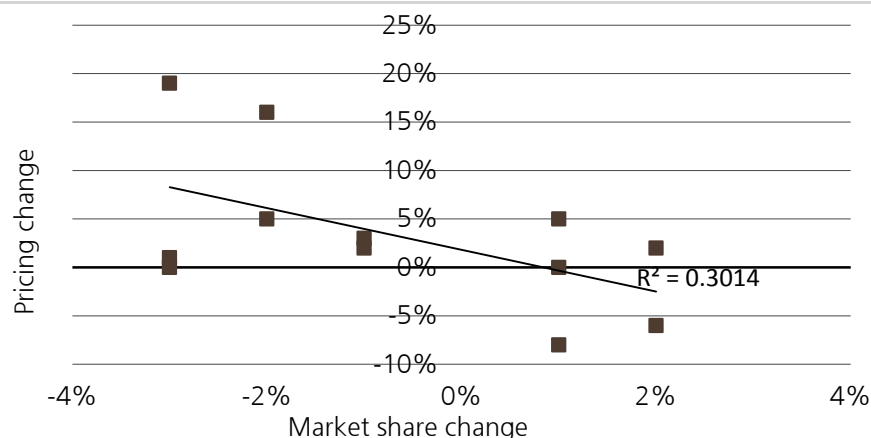
Top 20 markets with price increase			Top 20 markets with price decline		
City	Country	Change	City	Country	Change
Bali	Indonesia	49%	The Hamptons	United States	-43%
Cairo	Egypt	48%	Lagos	Nigeria	-42%
Spokane	United States	46%	Nairobi	Kenya	-41%
Iowa City	United States	44%	Oxford	United States	-33%
Ahmedabad	India	40%	Reading, Pa	United States	-27%
Bangkok	Thailand	33%	Harrisburg	United States	-26%
Hanoi	Vietnam	33%	Greater Maine	United States	-26%
Athens, Gr	Greece	32%	Santiago	Chile	-25%
Honolulu	United States	31%	Jackson	United States	-25%
Hampton Roads	United States	31%	Myrtle Beach	United States	-24%
Chennai	India	29%	Casablanca	Morocco	-23%
Austin	United States	24%	Rostov-On-Don	Russia	-23%
Johannesburg And Pretor	South Africa	23%	Coastal Georgia	United States	-23%
Jakarta	Indonesia	21%	San Francisco Bay Area	United States	-22%
Erie	United States	20%	Santo Domingo	Dominican Reput	-21%
Bangalore	India	20%	Minsk	Belarus	-21%
Surat	India	20%	Eastern Province, Ksa	Saudi Arabia	-20%
Chandigarh	India	20%	Jeddah	Saudi Arabia	-20%
Lancaster, Pa	United States	19%	Riyadh	Saudi Arabia	-20%
Kolkata	India	19%	San Jose, Costa Rica	Costa Rica	-20%

Source: UBS Evidence Lab

Let's now try to find out if there is a strong correlation between changes in pricing and changes in market share (measured as a percentage of app downloads). We have run all possible correlations, but we did not find any strong ones.

We found no strong correlation between changes in market share and changes in pricing

Figure 31: Correlation between change in pricing vs change in market share



Source: UBS Evidence Lab

This can be explained by:

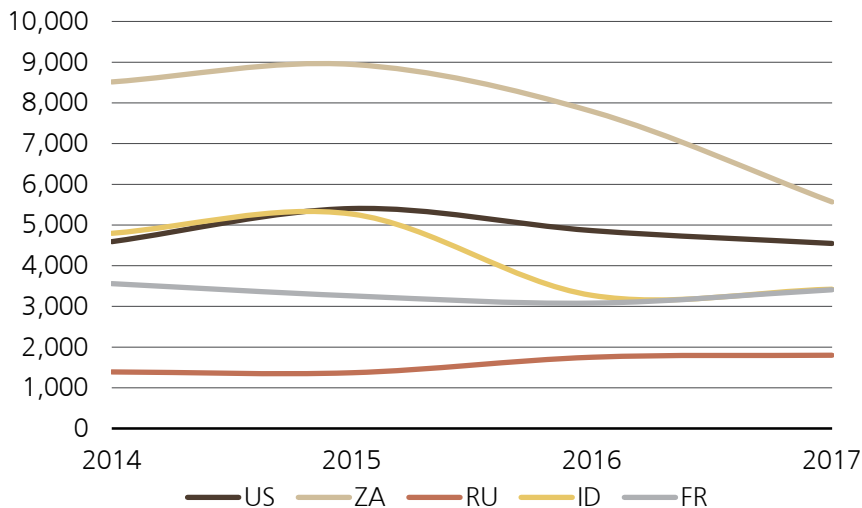
- **Lack of pricing transparency:** People initially download a shared mobility app without having much information on pricing.
- **Lack of supply:** Increasing pricing might be more relevant initially to address the lack of supply and attract new drivers. Our app downloads analysis does not capture data on supply. In Figure 31, we can see that the lower the change in price, the higher the market share gain (as a percentage of downloads).
- **Mispricing.** When a new market is launched, the platform is initially "navigating in the dark" and may not be able to optimise its pricing policy, given the lack of information available.

- **Uber is not a price leader.** We are looking at UberX, which may not be the price leader in a given market.

Key regional competitive dynamics

We have taken a closer look at the regional competitive dynamics and build an HHI concentration index by region (Figure 32).

Figure 32: HHI concentration index by region

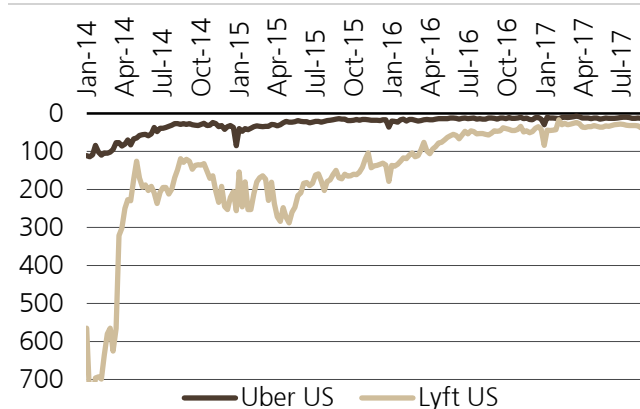


Source: Sensor Tower, UBS Evidence Lab

Note: Based on the share of global downloads.

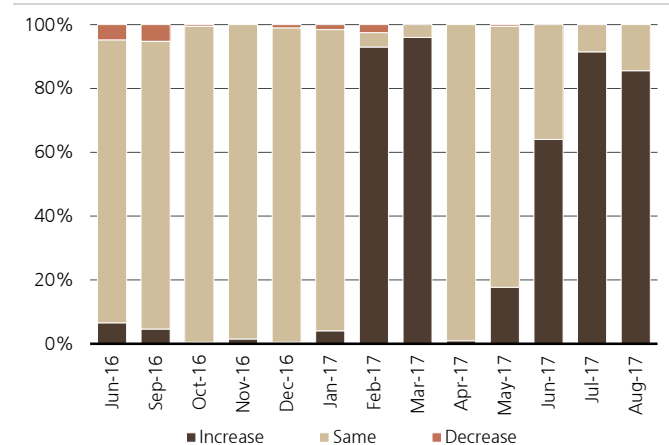
- **Uber is the leader and a local competitor is emerging** – examples are South Africa and the US. For instance, in the US, Uber currently has a 60% market share (down from 71% in 2015), but the ranking of the Lyft app has caught up fast with Uber's (Figure 33). It seems that most of the declining market share can be attributed to higher prices (Figure 34). We found that the share of cities in which UberX prices have increased is highest in the US at ~80% of the total cities over the June-August period.

Figure 33: US app download ranking (iOS) comparison between Uber and Lyft



Source: Sensor Tower, UBS Evidence Lab

Figure 34: UberX pricing trends since June 2016 in the US



Source: UBS Evidence Lab

- **Battleground market for Uber** – primarily southeast Asia, as Uber comes into competition with Grab, in India versus Ola, and in Russia versus Yandex Taxi for now. In Figure 32, we can see that Russia is already one of the most concentrated markets.
- **Uber has defeated an incumbent** – such as in Latin America versus Easy Taxi.
- **Local company is leader** – such as Kakao in South Korea and Gett in Israel.

Riding towards free transport: impact of robotaxis

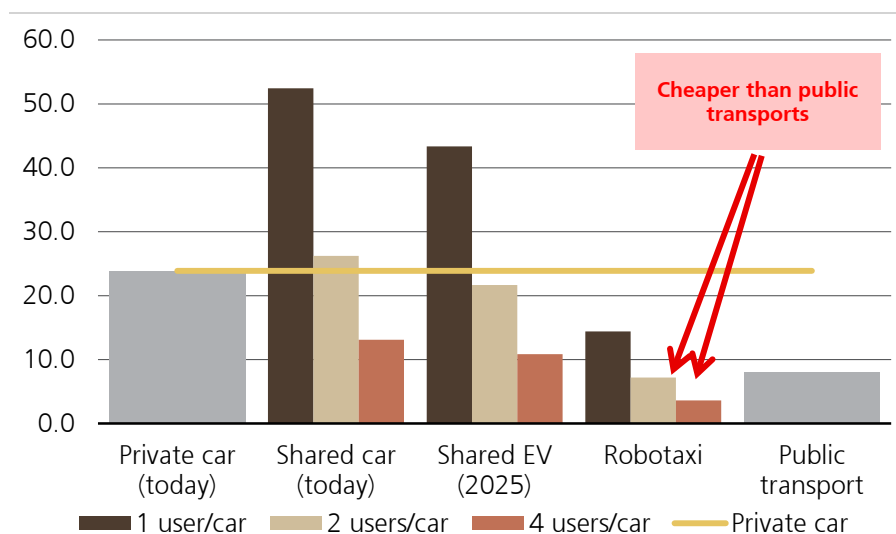
It seems most people do not fully appreciate the financial benefit of using ride-on-demand as yet, since "less expensive than owning a car" is ranked only 4th in the reasons for using ride-on-demand (Figure 51).

In Figure 35, we show the cost of the daily commute to work, assuming 20km for each leg. If two passengers share the trips in a robotaxi, the related cost per day would be €7.2 for each passenger, or almost 4 times cheaper than using their own car to drive to work. Earlier this year, we hosted a lunch meeting with the head of business at Gett, and he estimated that the cost per ride in an autonomous world will fall to US\$1.00-1.50 for a car with a five-year life. We get to a cost per trip of €14.4, assuming one passenger and 20km travelled.

Robotaxi will be 4x cheaper than owning a car

There is also an opportunity cost that is not to be underestimated, since the shared mobility user will be able to free up about two hours per day, since he/she is not driving.

Figure 35: Daily commute costs (assuming 40km/day or 20km/trip) (London) (€)

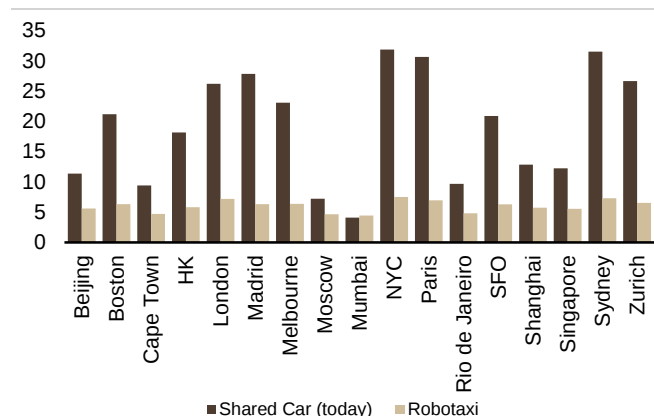


Source: UBS estimates

Note: The cost for private ICE stays the same, as the private car owner is unlikely to split the cost by the number of passengers in the car.

We think ride-on-demand could rapidly become a mode of transport of choice within the urban landscape. We have built an interactive model (available on UBS Neo, [click here](#)) which looks at 17 cities globally and compares the cost of owning a car with that of using "robotaxis" for the daily commute to work.

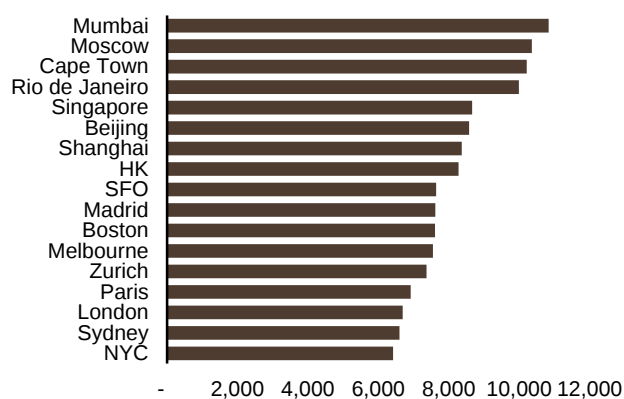
Figure 36: Cost of a daily commute (€)



Source: UBS estimates

Note: ICE stands for "internal combustion engine", assuming 2 passengers per robotaxi and a daily commute of 40km

Figure 37: How many km can you buy in a robotaxi using the proceeds from selling your car?



Source: UBS estimates

Note: Assuming the annual running costs of owning a private car are spent on robotaxis.

Figure 38: UBS interactive model – cost of owning a car versus using robotaxis



Global Research

28th September 2017

Global autos

How much could you save by switching to robot taxis?

Select:

1. City you live in

2. Number of km driven / year

3. Fuel costs (€/l)

4. Electricity costs (€/kWh)

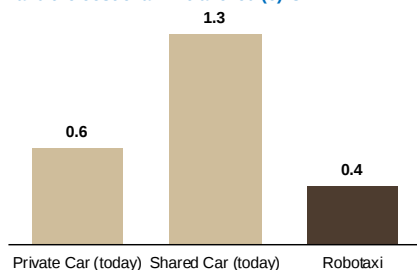
We have used electricity cost in Germany i.e 0.30 €/kWh

Now select:

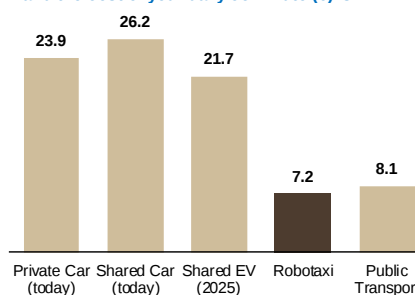
5. Daily commute (km/day)

6. No of passengers / shared vehicle / robotaxi

... and the cost of a km travelled (€) is:



... and the cost of your daily commute (€) is:



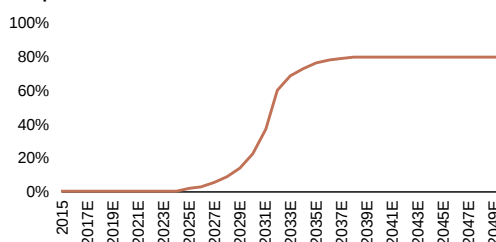
What if you were to get rid of your private car...

... you could travel kms/year and save € per year using a robot taxi

Robotaxis: what are the implications for the auto industry?

Choose Scenario:

Adoption rate of robotaxis



See next tab for detailed impact on new car sales, fleet mix, number of miles driven, etc.

Related Research

- [2016 07 20 UBS Evidence Lab: Shifting from car ownership to shared mobility](#)
- [2016 07 20 Q-Series: What Is the Scope of the Sharing Economy?](#)
- [2015 11 24 Q-Series: Could 'ride-on-demand' end car ownership?](#)
- [2015 04 28 UBS Evidence Lab: 'Car-on-demand' - more consumers than sharers](#)
- [2014 09 25 Q-Series: How disruptive is 'car-on-demand' for autos?](#)

Source for all figures: UBS estimates; Notes: ICE stands for Internal Combustion Engine and EV for electric vehicles

This interactive model was developed in conjunction with the published report listed above; please reference the report for details on the model's assumptions. The model provides graphical scenario outputs based on changes the user can make to certain inputs. These outputs are hypothetical and do not reflect the research analyst's views, forecasts or valuations. The model may not be updated after being first published and therefore may not be current.

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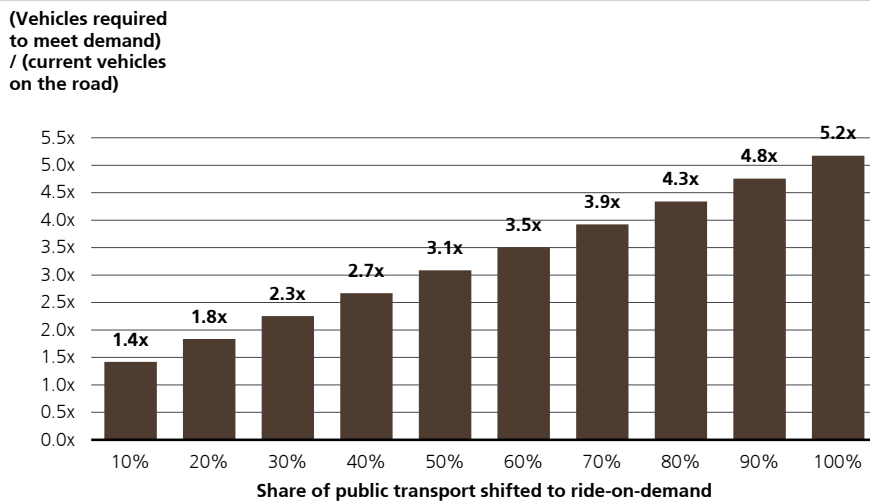
Source: UBS estimates

Can city infrastructure deal with people giving up public transport?

In Figure 39, we have modelled how many additional ride-on-demand vehicles would be required in London for ride-on-demand to replace public transport. We estimate that a 10% shift from public transport towards ride-on-demand would require ~35,000 additional vehicles on the road. This translates into a ~40% increase in the current number of licensed taxis/private hire vehicles in London, or an ~18% increase in road traffic in London's congestion charging zone.

10% of users giving up public transport mean 40% more taxis required

Figure 39: A 10% shift from public transport to 'ride-on-demand' requires a >40% increase in taxis/private hire vehicles in London



Source: UBS estimates

Note: We assume that the average vehicle is being shared by three people.

International Transport Forum: shared on-demand buses

Last year, we hosted a call with the secretary general of the International Transport Forum (ITF). They had built a model analysing the impact of replacing all cars and bus trips in a city with fleet of shared on-demand vehicles. The conclusion was that (1) only 3% of today's fleet would be required; (2) congestion would disappear; (3) the total number of required parking spaces would be reduced by 95%; (4) CO2 emissions would be reduced by a third. For more information, please refer to our note: ['Global Autos: Lane Assist Series – What would a city without private cars look like?'](#).

The ITF's assumptions are:

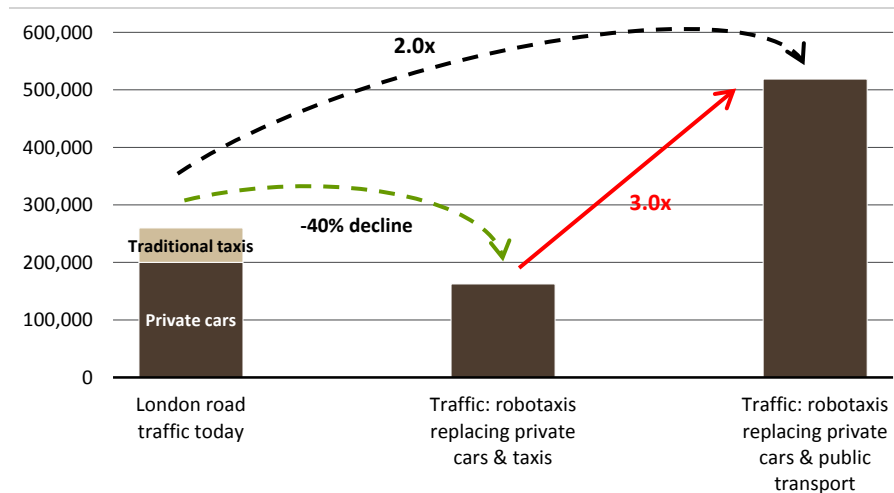
- For its modelling, ITF relies on minibuses with an average of 6-15 passengers per vehicle. In contrast, we model sharing with traditional cars that are shared 50% of the time by three passengers per vehicle and occupied by just a single passenger the rest of the time.
- Pre-defined pick-up points that can be up to 400m away compared to the user's current location.
- 30 minutes' advance booking required.

What if cities were to ban private vehicles entering cities?

In this scenario, we assume that all private cars and taxis are replaced with robotaxis. We estimate that the road traffic, measured as the number of cars entering the congestion charging zone in central London, would increase by more than 100%.

100% shift from public transport to robot-taxi would result in traffic more than doubling

Figure 40: Impact of robotaxis on daily road traffic in central London



Source: UBS estimates

Note: Road traffic is defined as the number of private cars and traditional taxis entering London's congestion charging zone per day. We assume that robotaxis are shared 50% of the time by four passengers. The other half of the time, robotaxis carry only one passenger per car.

The impact is likely to be mitigated by the fact that parking space will no longer be required, allowing more vehicles to drive around the city. The International Transport Forum estimates that all on-street parking could be removed and more than 80% of off-street parking will no longer be needed. In the urban United States, the automobile (open and closed parking) consumes close to 50% of the land area of cities. In LA, this figure approaches two-thirds. In addition, real-time traffic information digitally supplied to the vehicle will continuously optimise the trip.

Parking no longer required – will free up some space

Finally, we think ride-on-demand could potentially have a net positive impact on congestion, as cars will be used in a smarter way (assuming the shift from public transport to ride-on-demand is not too large). A study done by the HubCab I MIT Senseable City Lab showed that about 90% of the taxi trips in NYC could be shared if each user was willing to lengthen the trip by an average of five minutes, reducing the total distance travelled by 40%.

Are consumers ready to use robotaxis?

The "car of the future" will most likely be electric, autonomous and shared. In this section, we use various tools provided by UBS Evidence Lab to measure the willingness of consumers to ride in robotaxis.

We have conducted our third consumer survey on shared mobility, involving 15,000 participants across five countries. For all the details on how things have evolved in our three consumer surveys, please refer to Figure 96 and Figure 97 in the Appendix. We also analysed app download trends for ~40 of the largest ride-on-demand and car-sharing services. This is the fifth time we have run this analysis.

The main takeaways include: (1) ride-on-demand using continues to increase globally; (2) public transport usage seems to be more at risk and most disrupted in the medium term; and (3) people are not ready to give up their car (yet). We also found that the acceptance level for autonomous cars is already relatively high for a technology which has yet to become available and mainstream. ~30% of the respondents indicated that they would be interested in using an autonomous car and 31% are undecided.

Robotaxis could have a strong growth potential

Figure 41: Our 4 key findings from UBS Evidence Lab

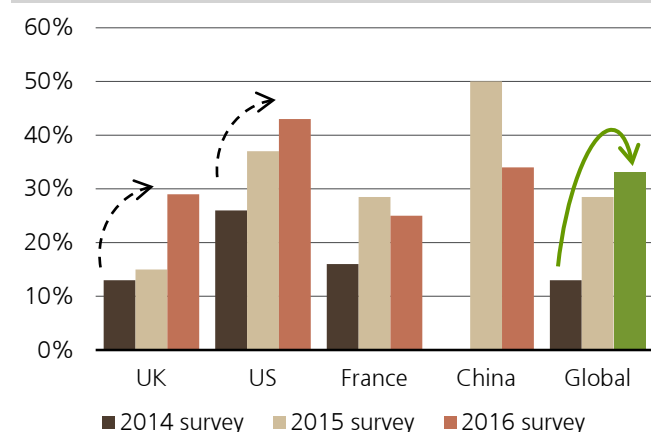
- 1 Ride-on-demand usage continues to increase
- 2 Public transports mostly disrupted in the medium term
- 3 People not ready to give up their cars (yet)
- 4 The acceptance level for autonomous cars is already relatively high

Source: UBS Evidence Lab

Key finding 1: Ride-on-demand usage continues to increase

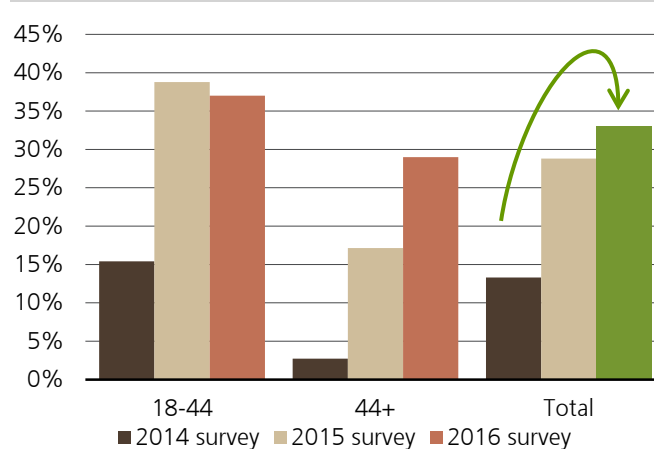
Our UBS Evidence Lab consumer survey conducted in 2016 shows that the proportion of consumers who increased their use of ride-on-demand increased slightly to c33% of respondents, from 13% in 2014. The proportion of 44+ year olds increasing their usage continues to improve to 21% from 17% in 2015 and only 3% in 2014. This age bracket corresponds to the typical car buyer today.

Figure 42: Ride-on-demand usage continues to increase in most regions... (% of respondents that have increased their 'ride-on-demand' usage over the last six months)



Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.

Figure 43: ...and in most age categories (% of respondents that have increased their 'ride-on-demand' usage over the last six months)



Source: UBS Evidence Lab. For the 2016 survey, age categories deviate: 18-34 year olds and 34+. For the 2014/15 surveys as shown in chart.

Ride-on-demand apps' popularity remains very strong

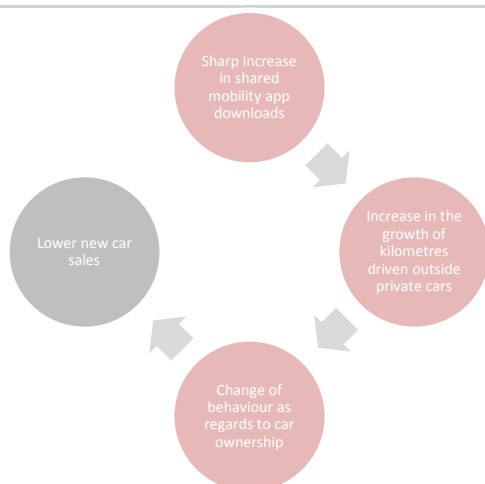
We update our app analysis for ride-on-demand services for the fifth time in about two years. We are now tracking more than 120 services across 40+ countries. We come to three key conclusions:

- **Strong popularity continues:** The run-rate of app downloads for Uber and ride-on-demand as whole is running at a 2-5x multiple of new cars sold globally (Figure 45).

UBS Evidence Lab analysed the app rankings of ride-on-demand (ROD) services to better understand popularity across countries. We looked at the ride-on-demand app with the highest ranking over the previous four weeks (relative to all free apps). Figure 46 shows that, in many key markets, ride-on-demand is ranked in the top 100 in the iOS iPhone store. Interestingly, in many countries, the highest-ranked ride-on-demand app is not Uber.

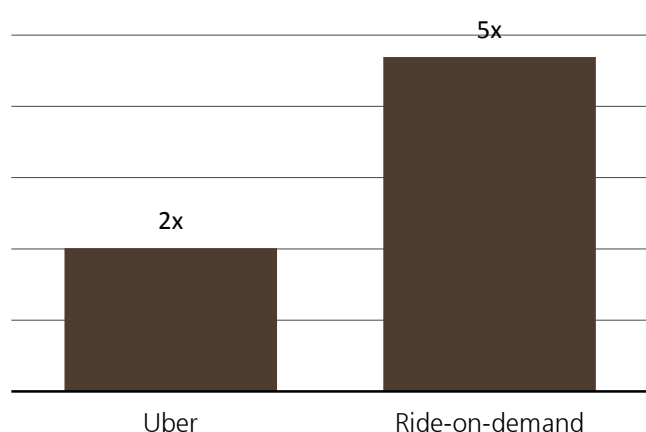
A unique time series is emerging

Figure 44: Connecting shared mobility app downloads to future new car sales



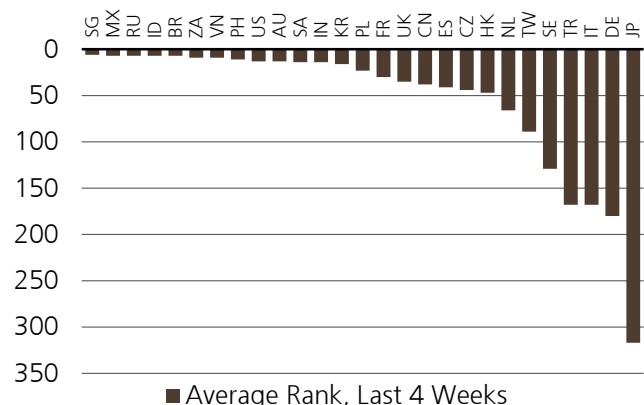
Source: UBS

Figure 45: Uber/ROD services app downloads as a multiple of new cars sold globally



Source: UBS Evidence Lab, Sensor Tower

Figure 46: Popularity of ride-on-demand apps in key markets

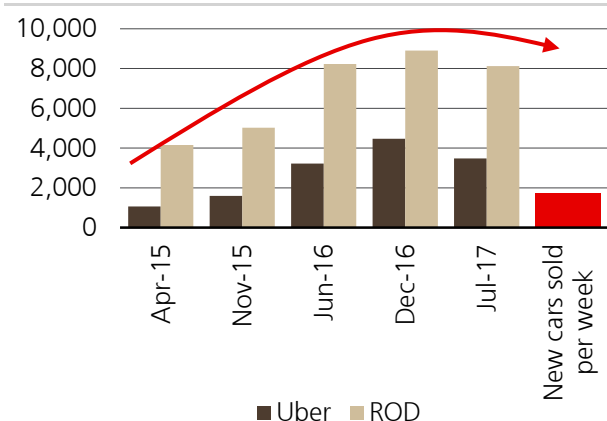


Source: UBS Evidence Lab, Sensor Tower

Note: Lower ranking (closer to 0) indicates service is more popular.

- **App download growth momentum is slowing:** For the first time since we first ran our analysis, we are seeing the run-rate of app downloads broadly stable year-on-year, compared to triple-digit percentage increases in the past (Figure 47). We note that the slowdown globally has been mainly driven by China, where people seem to have shifted their preference to bike-sharing apps. If we adjust for China, most markets are still increasing at a double-digit pace (Figure 48).

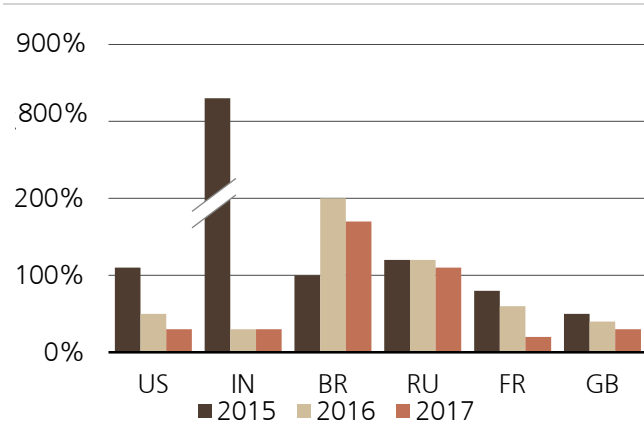
Figure 47: Number of downloads of the Uber app and ride-on-demand apps overall per week vs number of new cars sold per week ('000s)



Source: UBS Evidence Lab, Sensor Tower

Note: Calculated as the average weekly run-rate in '000s over the quarter ending at specified month's end for Uber and across all ROD apps (including taxi service and carpool apps).

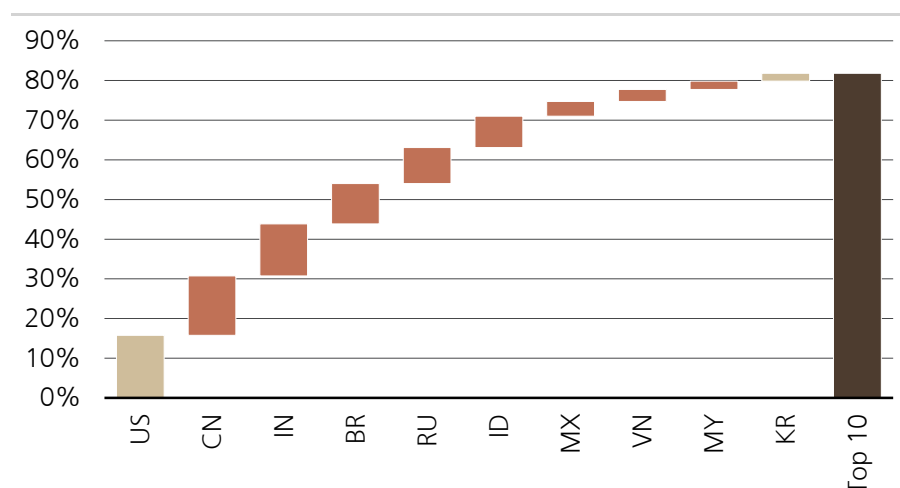
Figure 48: App downloads growth rate by region



Source: UBS Evidence Lab, Sensor Tower

- **Emerging markets remain the main contributors:** The top 10 largest markets contribute 82% of the app downloads globally. Eight of the top 10 are emerging markets. It shows a high level of interest for these new forms of mobility despite the lower level of penetration of cars.

Figure 49: Contribution to "Ride-on-demand" app downloads by country so far this year* (in millions)



Source: UBS Evidence Lab, Sensor Tower.

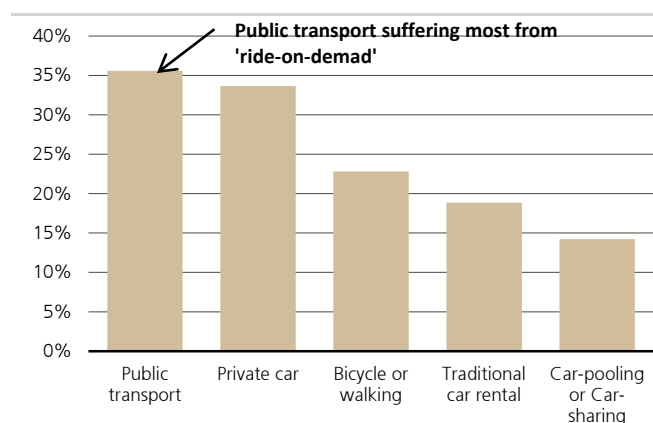
Note: We removed countries where we did not have Google Play data, except China where we assumed equal numbers of iOS and Android downloads. * Our analysis was run in August.

Key finding 2: Public transport most affected

Public transport travellers are increasing their usage of ride-on-demand...

Our UBS Evidence Lab findings suggest that public transport is most affected by a shift towards ride-on-demand, with more than 35% of respondents indicating increased usage of ride-on-demand at the expense of public transport (Figure 50). Convenience and cost are the two main reasons why people are using shared mobility (Figure 51). Interestingly, those are also the reasons why people own a car.

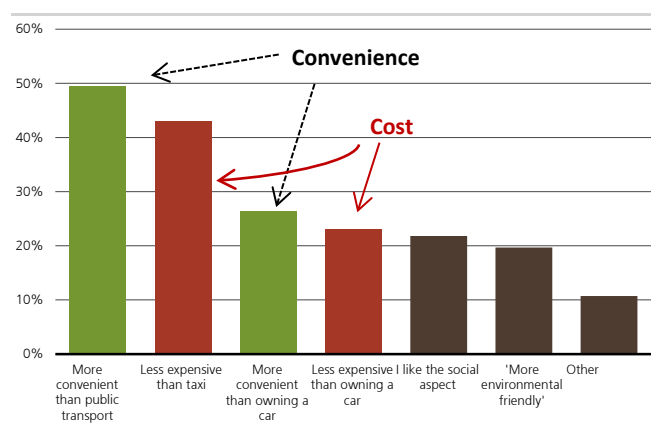
Figure 50: Mode of transportation used less due to the increasing usage of ride-on-demand



Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.

Note: Multiple mentions possible.

Figure 51: Convenience and cost remain key reasons for using ride-on-demand



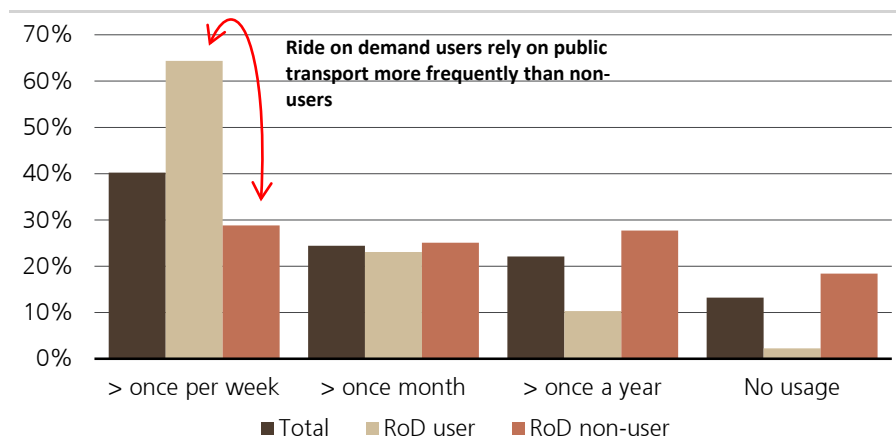
Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.

Note: Multiple mentions possible.

...but still rely heavily on public transport

As shown in Figure 52, our UBS Evidence Lab survey indicates that ride-on-demand usage and usage of public transport go hand in hand. About 64% of consumers that have used ride-on-demand in the past rely on public transport at least once a week, compared to only 29% for the surveyed users that have never used ride-on-demand before.

Figure 52: Ride-on-demand users rely on public transport more frequently



Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.

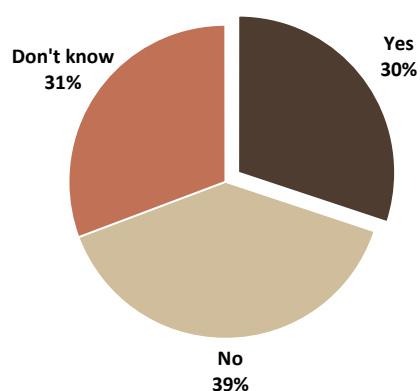
Note: Percentage of respondents selecting frequency of a given usage category.

What do consumers think about robotaxis?

Our Evidence Lab survey indicates that acceptance of autonomous cars is already relatively high for a technology that has yet to become available and mainstream. Some 30% of the respondents indicated that they would be interested in using an autonomous car, and 31% are undecided. In other words, almost two-thirds of the respondents could be open to this new form of mobility. Acceptance of robotaxis is highest in China, where 36% of respondents would be interested, while Japan (22%) has the lowest acceptance rate in the survey.

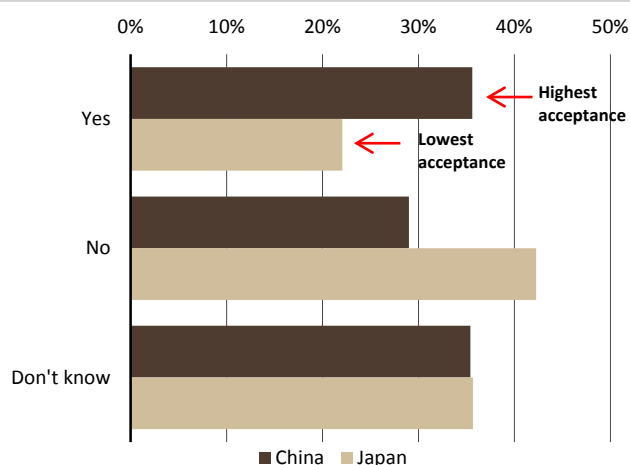
Acceptance of robotaxis is already fairly high

Figure 53: Willingness to use an autonomous car is already quite high...



Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.

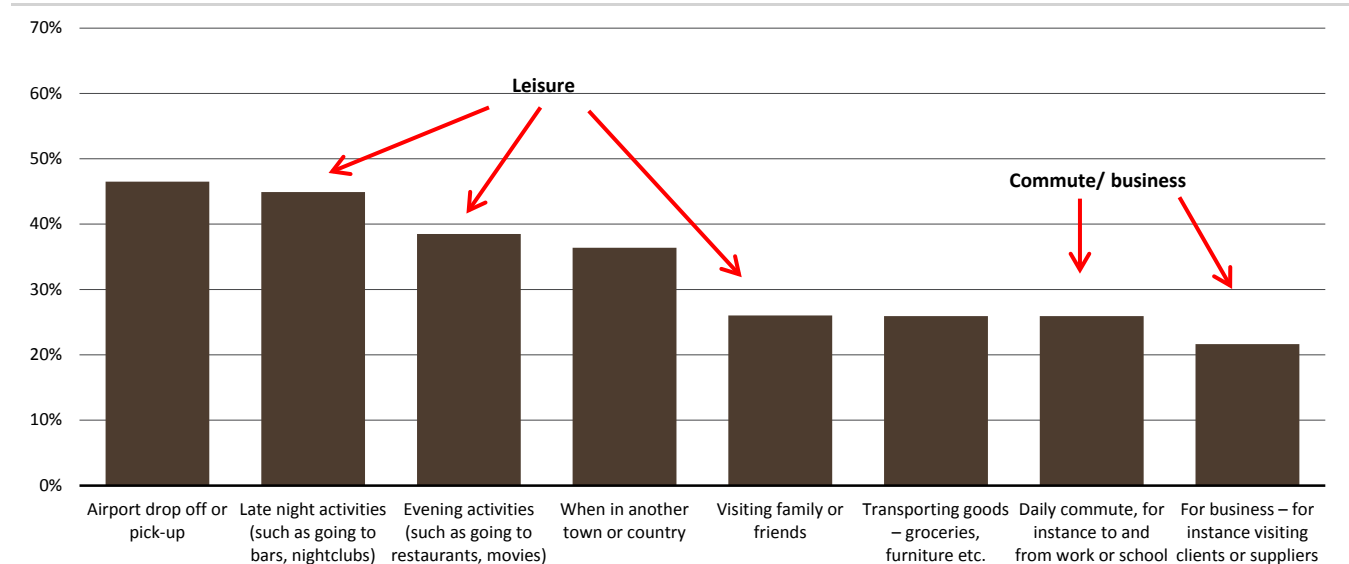
Figure 54: ... with the highest acceptance for autonomous cars in China



Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.

As shown in the chart below, people are more likely to rely on autonomous vehicles for leisure-related trips than for the daily commute or business trips. Airport drop-offs or late-night journeys are among the activities most frequently mentioned, at 47% and 45%, respectively (multiple mentions possible by category). In contrast, only 26% and 23% would rely on an autonomous car for daily commutes to work/school or business trips.

Figure 55: People more likely to want to use autonomous vehicles for leisure than for the daily commute/business trips



Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.

Note: Mentions by category, multiple mentions possible.

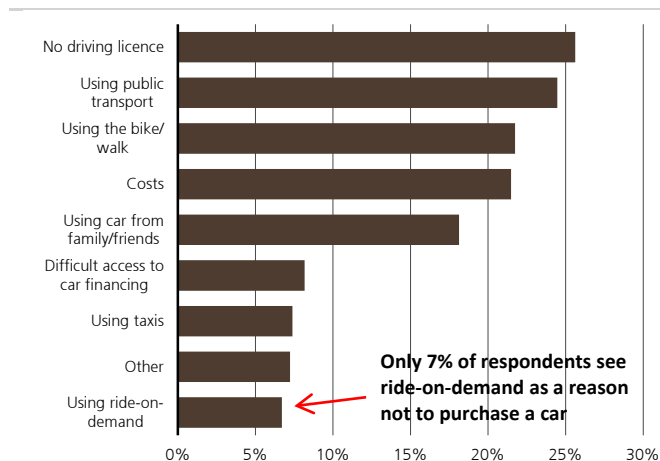
Key finding 3: People not ready to give up their car (yet)

Our UBS Evidence Lab survey shows that people are not ready yet to give up car ownership, despite the increasing usage of ride-on-demand.

Key reasons for not purchasing a car, in order of importance, are: (1) the lack of a driver's licence (~26% of respondents mention this); and (2) the use of public transportation (24% agree). However, only ~7% of respondents highlight that ride-on-demand is a reason for not purchasing a car. Conversely, 69% of the respondents agree with the statement that ride-on-demand will never fully replace car ownership. At the same time, 47% agree that using ride-on-demand is cheaper than owning a car.

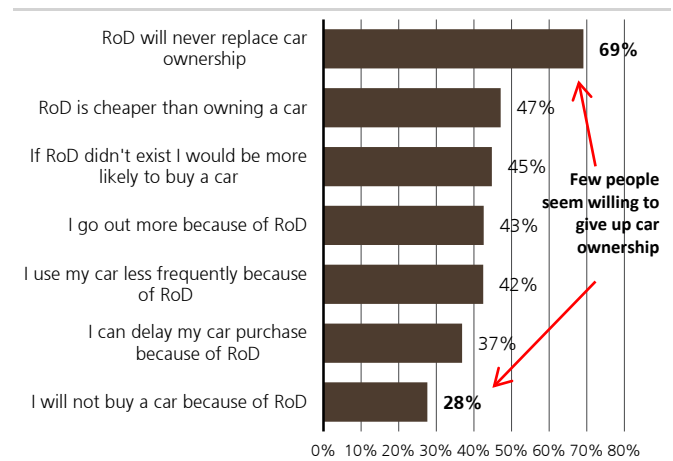
Only ~7% of respondents say ride-on-demand is a reason for not purchasing a car

Figure 56: Reasons for not intending to purchase a car



Source: UBS Evidence Lab 2016 ride-on-demand consumer survey
Note: Multiple mentions possible,

Figure 57: Attitude towards shared mobility (statements respondents agree with)

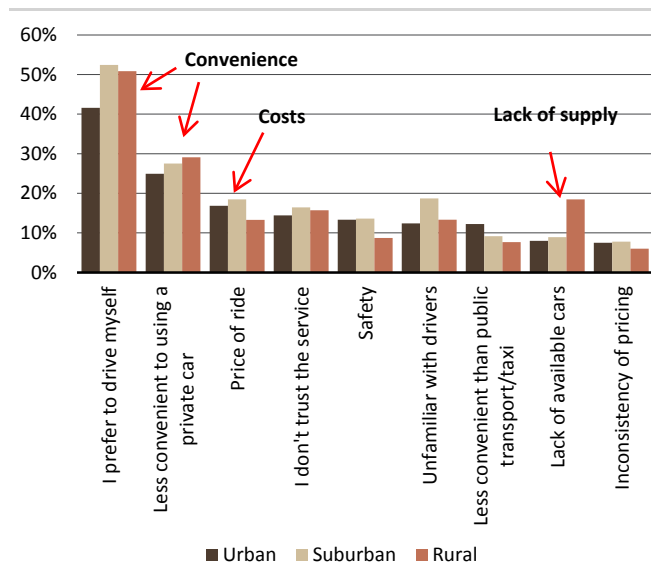


Source: UBS Evidence Lab 2016 ride-on-demand consumer survey
Note: Multiple mentions possible.

Convenience remains one of the key hurdles to address

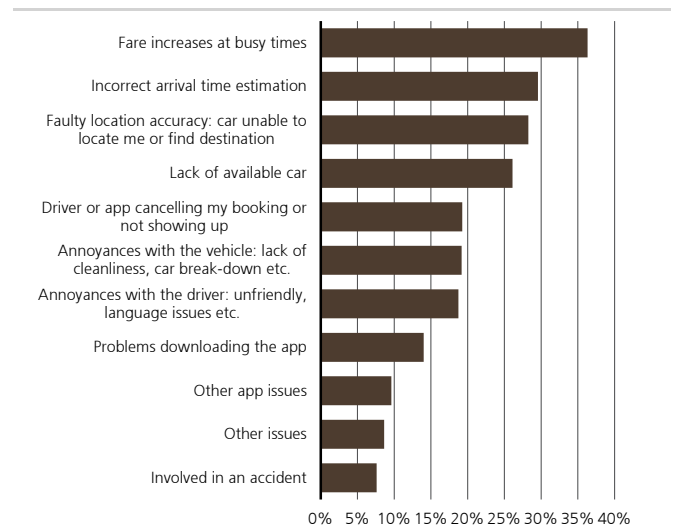
In Figure 58, we show the arguments coming up most frequently for not using ride-on-demand. The key three arguments can be categorised as: (1) convenience; (2) costs; and (3) lack of supply.

Figure 58: Reasons for not using ride-on-demand



Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.

Figure 59: Key obstacles experienced using ride-on-demand



Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.

People own a car because it is convenient, whereas the financial rationale for owning a car does not seem to be very important. As a consequence, the operator has to address this convenience issue first. One way of doing so is to deliver a pick-up time within a maximum of 2-3 minutes. If people are convinced they can get a car as soon as they need one, they may rethink the car ownership rationale and consider selling at least one car before potentially giving up car ownership completely.

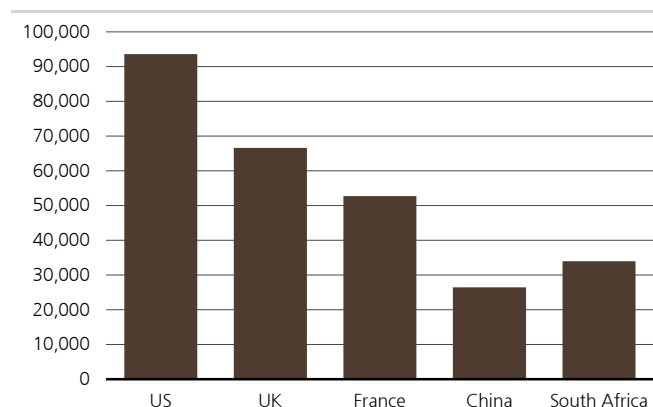
On the **supply side**, ride-on-demand platforms have to ensure that the economics for the drivers remain attractive, even as the number of drivers increases (until they are replaced by robotaxis). This will mean ensuring a sufficiently high utilisation rate as ride-on-demand platforms continue to scale.

Looking at the **demand side** of the equation, we think the following will be key: (1) offering good market coverage; (2) minimising the waiting time; and (3) gaining consumers' trust, which would then end in people giving up car ownership.

Who is the typical ride-on-demand user?

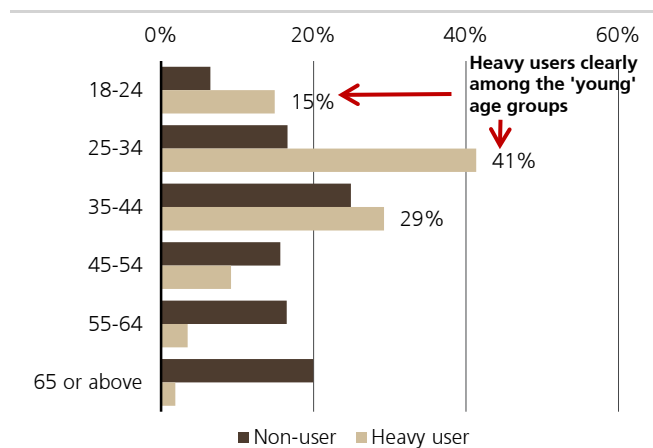
Our profile analysis is based on our UBS Evidence Lab consumer survey and focuses solely on heavy users, which we define as using ride-on-demand services more than three times per week. Below, we summarise key demographic and other findings.

Figure 60: Heavy users – mean household income (€)



Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.
Note: Converted at current exchange rates.

Figure 61: Total respondents – age distribution



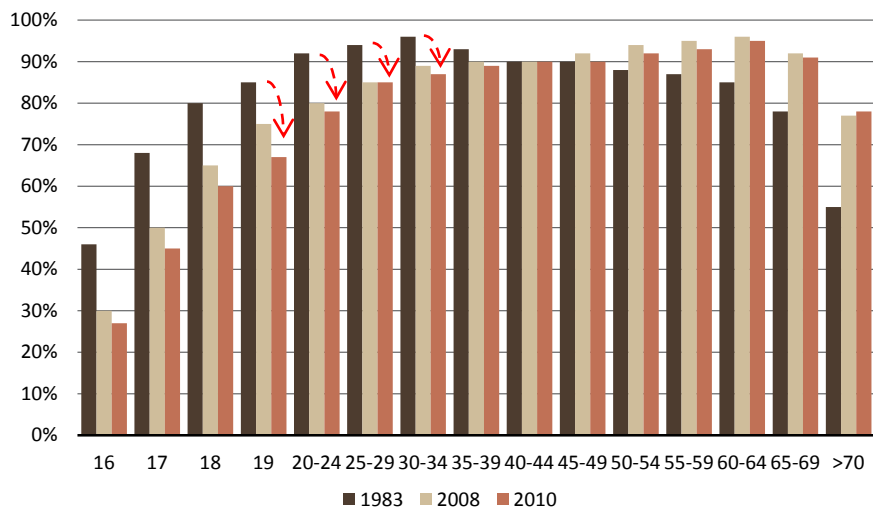
Source: UBS Evidence Lab 2016 ride-on-demand consumer survey.

- **Gender:** Some 44% of heavy users are female.
- **Age:** Among the heavy ride-on-demand users, the 25-34 year olds account for the largest group (c41%), followed by the 35-44 year olds, who represent 29% of the sample. Unsurprisingly, ~85% of the heavy users are less than 45 years of age, which compares with just ~48% of respondents who have never used ride-on-demand.
- **Car ownership:** Some 70% of heavy users in our survey own a private car/SUV. Of those who own a car, 60% own only one vehicle, whereas 33% own two vehicles.
- **Education:** For 51% of heavy users, the highest level of education is a Bachelor's degree or equivalent, while 18% have a Master's degree or Doctorate.
- **Household income:** The mean household income of our heavy users is c£59k (€66k) in the UK, €52.7k in France, cUS\$110k (€93k) in the US, cRMB178k (€26k) in China, and R532k (€34k) in South Africa.
- **Employment:** 80% are employed full-time, 9% part-time, and 5% are students.

Decline in number of young people with driving licence accelerating

Data on driving permits below indicates that young people in the US are less likely today to get a driver's licence, with rates dropping most among the younger age brackets. According to data from *The Atlantic*, the share of 20-24 years old having a driver's licence dropped by 12 percentage points between 1983 and 2008, and by 3 percentage points between 2008 and 2010.

Figure 62: Fewer young people have driving licences in the US (years of age)



Source: *The Atlantic*, UBS

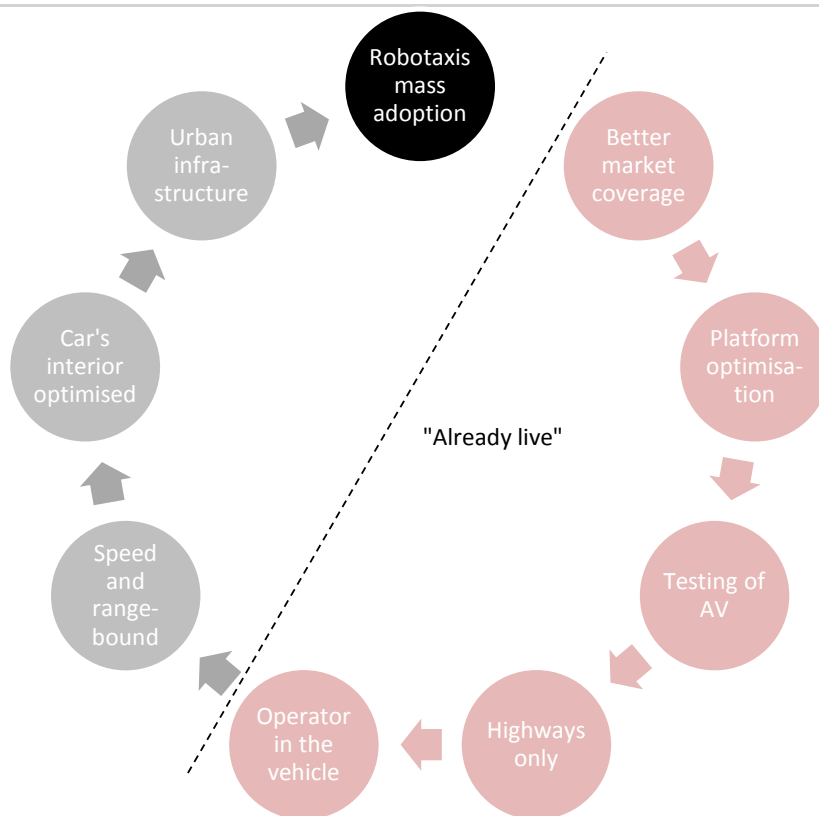
Impediments to making robotaxis a reality

There are a number of impediments and challenges to overcome before robotaxis become a reality. These include: (1) customer attitudes to being driven without a driver; (2) regulation, which currently is not appropriate for such a reality; and (3) design, security and technological challenges.

Roadmap towards robotaxis' mass adoption

In Figure 63, we show the steps required to reach mass adoption of robotaxis. Interestingly, most are "already live" in the sense that they have been or are being tested. The next important step will be testing robotaxis in speed- and range-bound areas in cities. This should start as early as next year in Singapore.

Figure 63: Roadmap towards robotaxis' mass adoption



Source: UBS

The individual steps as we see them are:

- **Better market coverage** of shared mobility fleets (with drivers);
- **Platform optimisation** to connect supply with demand in order to address the user's convenience issue (i.e. deliver a vehicle in less than three minutes anytime and anywhere);
- **Platform/OEMs testing of autonomous vehicles;**
- **Commercial launch of autonomous features (highways only);**

- **Testing of robotaxis** (with an operator inside the car controlling the systems): Uber has been running some tests in Pittsburgh;
- **Speed- and range-bound robotaxis** in cities (with an operator monitoring a given number of vehicles): nuTonomy plans to launch a commercial autonomous taxi service in Singapore in 2018;
- **Interior of the car** redesigned in order to maximise the user's experience;
- Cities adapting the **urban infrastructure**;
- **Mass adoption:** Speed- and range-bound **robotaxis** in cities (no operator monitoring).

Will regulation be a hurdle or help facilitate?

The biggest challenge facing the electric, autonomous and shared vehicle is a variety of regulatory risks. Many of the players operate within traditionally regulated markets (licences, labour and taxes). Other notable risks include elevated concerns of consumer protection, privacy and security, and impact to the environment.

- **Taxi industry regulations:** One of the key regulatory challenges ride-on-demand companies are facing is to what extent they are regulated by local taxi industry standards and laws, posing questions on their legal status to operate (which varies from market to market). Traditionally, the taxi industry has been heavily regulated to ensure driver and rider safety, by imposing a standard of driving proficiency and background checks through licensing requirements. Taxi cars are also required to go through periodic inspections. These requirements are not directly applicable to companies such as Uber and Lyft, leading to constant questioning over the effectiveness and proficiency of their background check procedures and vehicle safety. One should not underestimate the powerful taxi lobbies, as evidenced by Transport for London deciding not to renew Uber's licence at the end of September. There will always be a tussle between incumbents and disruptors. Even if the technology is ready, some elements of society might not be.
- **Labour regulations:** One of the major regulatory challenges faced by shared transportation companies in the US is the classification of drivers as independent contractors versus employees. This will not be an issue for **robotaxis**, but new job opportunities will have to be found for drivers.
- **Taxation:** Tax authorities have been slow to adapt historically. Robotaxi platforms could operate in grey areas when it comes to their tax liabilities.
- **Insurance:** One key legal question associated with the sharing economy is: "Whom to sue when something goes wrong?" The response from sharing economy players has increasingly been to utilise insurance to deal with the risks of especially severe/extreme circumstances, in particular those involving personal safety. The platform is likely to reflect this in the fee paid by the user.
- **Privacy and security:** A combination of ever-growing records on individuals' movements and activities, increasingly sophisticated data analytics, and a lack of visibility on how the collected data is used and monetised, may impede the growth potential of robotaxis. Government regulations are also tightening corporations' privacy protection practices. More than 90 countries and territories have now adopted comprehensive data protection laws (including

Traditionally, the taxi industry has been heavily regulated

What happens to traditional taxi/ride-on-demand drivers?

Who will be responsible in the case of an accident?
The passenger, the platform or the OEM/fleet manager?

every country in Europe), and the US has adopted sectorial data protection laws.

- Information Sharing and Analysis Center (ISAC): This was set up by the Alliance of Automobile Manufacturers and the Association of Global Automakers to allow member OEMs to share cybersecurity threats and vulnerabilities with one another. The ISAC will eventually open up to include auto suppliers as well.
- The Society of Automotive Engineers (SAE) is developing a guidebook with help from the International Organization for Standardization (ISO).
- **Cybersecurity risk.** Cybersecurity and regulation pose risks to the speed of adoption of robotaxis. Widely publicised hacks of Jeep, Tesla and BMW vehicles have shown that modern cars can be compromised through short- (Bluetooth/DSRC) or long-range (cellular) remote access. Cars will be subject to various forms of regulations pertaining to data/privacy laws, consumer protection, cybersecurity, vehicle safety and telecommunication regulations. Since most robotaxis will be driving in a low-speed environment in the city, we could imagine that there will be an emergency button that can stop the car in any condition. We also believe that the benefits generated by robotaxis will more than offset the cybersecurity risk worries.
- NHTSA/DOT/FTC: The National Highway Traffic Safety Administration, the US Department of Transportation and the Federal Trade Commission have teamed up to establish consumer data privacy and vehicle network security rules. According to officials, a final determination on government standards for regulation of vehicle cybersecurity is not expected until 2018.
- Cooperative Intelligent Transport Systems (C-ITS) platform: This is a European Committee for Standardization (CEN) and European Telecommunications Standards Institute (ETSI) initiative aiming to develop cybersecurity, technical and legal standards across the entire car big data value chain (OEMs, suppliers, service providers, telecom, etc.).

What if a hacker takes over control?

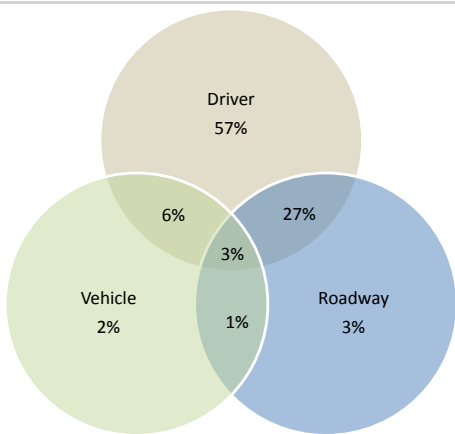
Additional benefits of robotaxis

Robotaxis will most likely save lives

Similarly, when looking at the reasons for accidents, driver errors are by far the single biggest factor, and many could be eradicated with the introduction of technology (speeding, inattention, alcohol impairment – account for 50% of accidents). Indeed, decision errors only accounted for c10% of crashes in a NHTSA study of 723 accidents, and even if technology causes false positives and fails from time to time, it appears evident that it could save a significant number of lives.

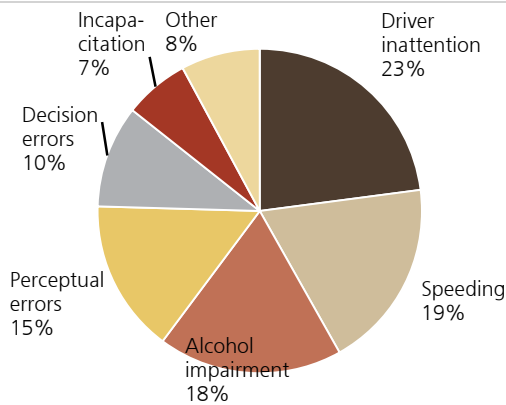
Most accidents are caused by human error

Figure 64: Causality of US road accidents



Source: US Federal Highways Agency

Figure 65: Causes of crashes (99% human – 723 cases)

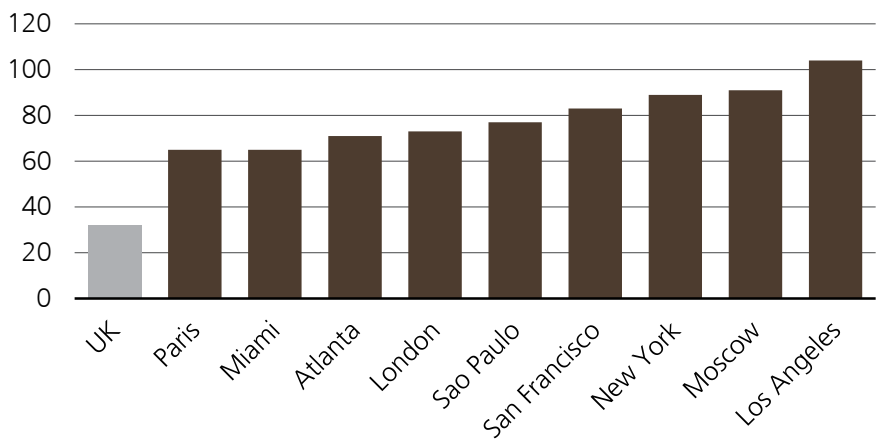


Source: NHTSA

Reduced congestion

According to a study conducted by TomTom, drivers spend 32 hours per year, on average, in traffic jams across the UK, versus 73 hours in London. This compares to around 75 hours per year for mega-cities such as Los Angeles, New York, San Francisco, Paris, Moscow, São Paulo and Miami. We estimate that ride-on-demand could have a net positive impact on congestion, as we assume cars will be used in a smarter way. Studies from the International Transport Forum (ITF) and the MIT Senseable City Lab on shared mobility support our view.

Figure 66: Time spent in traffic jams (hours per year)

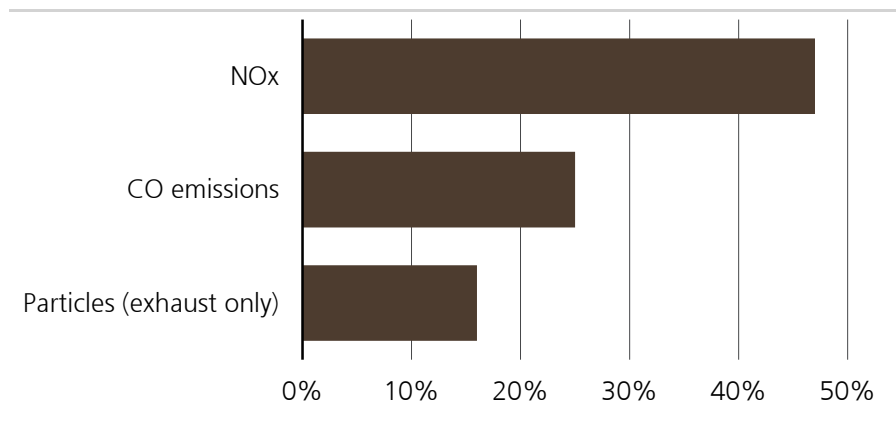


Source: Inrix, Auto Express

Cleaner air

According to data collected by the City of London, a large share of air pollution is caused by road transport. About 47% of total NO_x, 25% of CO and 17% of particle emissions (excluding from braking/tires) can be attributed to road transport. With overall vehicle kilometres driven in an electric car likely being increased due to ride-on-demand, air pollution from road transport, in turn, would also decline.

Figure 67: London air pollution – share caused by road transport



Source: London Datastore (2010), UBS

Noise reduction

Based on our estimates, a large part of the global urban car parc by 2040 will be fully electric robotaxis, which will emit significantly less noise than a conventional combustion engine car. In addition, better traffic management will likely reduce the noise from tyres, horns, sirens, door slamming and squeaking brakes or loud music.

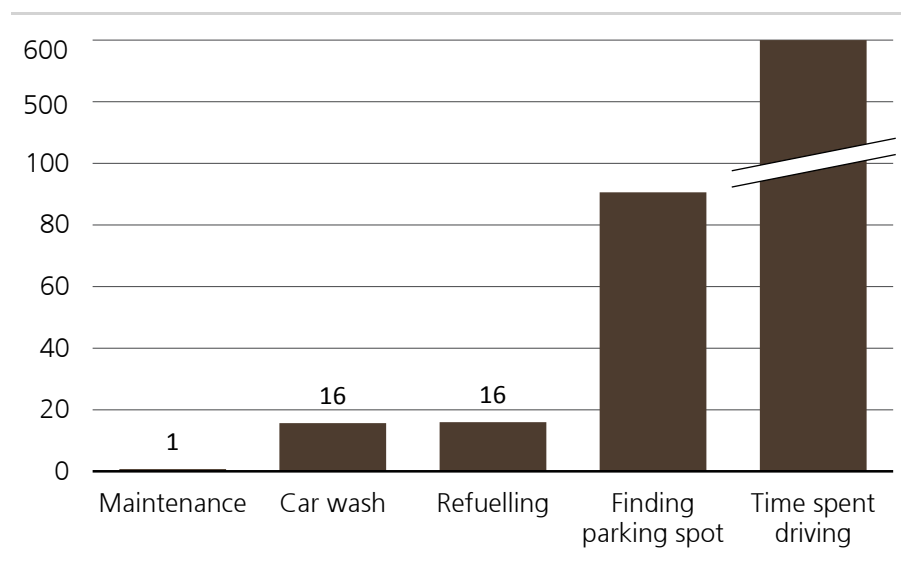
Greener cities

The ITF conducted a study simulating the use of shared buses in the city of Lisbon. It concluded that such a set-up would result in a 95% reduction in parking space, and a significant increase in available public space. The ITF estimates that the release of parking space could have a positive knock-on effect in the form of better walking and cycling conditions in large cities, resulting in a further reduction in total vehicle kilometres.

Freeing up time

In Europe/the UK, the average person spends 520 hours per year driving, 91 hours searching for a parking spot, 16 hours on refuelling and another 16 hours at the car wash, we estimate. In a robotaxi world, consumers would be able to find alternative ways to use the time on hand that would be otherwise lost. Passengers could focus on work, reading and entertainment, for instance, instead of having to actually drive the car or search for a parking spot.

Figure 68: Potential time savings from robotaxis (hours per year)



Source: UBS estimates

Note: Time spent driving and finding a parking spot are not mutually exclusive.

De-urbanisation

With robot-taxi improving overall access to mobility to city centres (reduced congestion and lower cost of using a car), the trend towards increased urbanization could potentially slow or even reverse, as hurdles for households to take advantage of lower property prices and superior living conditions in the suburbs will be greatly reduced. Longer term, this trend could imply a narrowing of the property prices gap between city centres and suburban areas, we think.

The main impacts for the auto industry

What are the implications for the auto industry?

We assume that 80% of the urban population could be using robotaxis from 2040. On that basis, we estimate that: (1) new car sales will be about 10% lower than our current estimates in 2050; (2) the size of the fleet will halve; (3) the number of kilometres driven will increase by 60%; (4) robotaxis will accelerate the penetration of electric cars, with 4-5x more EV sold in 2050 than our forecast for 2025.

OEMs will need to reinvent their business model and expand their activity into new areas such as fleet management, asset management, telco and media.

Suppliers with high exposure to ICE legacy products will have to manage the transition and diversify their offering. Suppliers with exposure to the key auto megatrends are well positioned to benefit. However, the landscape is likely to become more competitive with non-traditional tier one players gaining market share. The decline in aftermarket revenues will also be a headwind.

Tire makers are set to benefit from the increased number of kilometres driven, and we estimate that the annual cost for tires will be about 5x higher than in a private car today. Fleet buyers will put pressure on pricing but this will be offset by improving product mix (i.e. tires that can last longer).

We also include contributions from nine sector teams, including those covering oil, battery producers, chemicals, utilities and tech.

Our scenario analysis

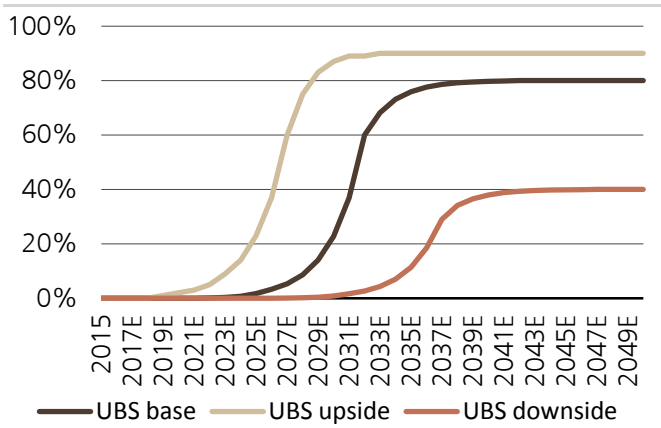
We have modelled three scenarios of adoption for robotaxis (see our interactive model available on UBS Neo). In our UBS base case, we assume the adoption rate of robotaxis will be 80% of the urban population by 2040, with the sharp increase in the S-curve happening around 2030. Fully autonomous vehicle technology will have been developed much sooner, but it will take some time before city authorities and regulators feel comfortable letting robotaxis on the road. We believe the population will benefit from the introduction of robotaxis as it will give better access to education, jobs and healthcare.

80% of urban population using robotaxis from 2040

Stress-testing our forecasts

- **UBS base case:** We assume that the adoption rate of robotaxis will be 80% of the urban population by 2040, with the sharp increase in the S-curve happening around 2030.
- **UBS upside case:** We assume that the adoption rate of robotaxis will be 90% of the urban population by 2030, with the sharp increase in the S-curve happening around 2025.
- **UBS downside case:** We assume that the adoption rate of robotaxis be reach 40% of the urban population by 2040, with the sharp increase in the S-curve happening around 2035. We also assume a lower vehicle utilisation rate of about 30-35%, similar to that of shared ICE vehicles today.

Figure 69: UBS scenarios for robotaxi penetration (as % of urban population)



Source: UBS estimates. Note: Urban only

Figure 70: UBS scenarios: key conclusions

	Downside	Base	Upside
Increase (reduction) in new car sales globally (2050)	4%	-10%	-8%
Increase (reduction) in the urban fleet (vs today)	18%	-48%	-62%
Weight of fleet buyers (%-pts) (vs today)	8%	27%	32%
Utilisation rate of robot taxis (%)	31 %	61 %	61 %
Number of kilometers driven/year (x) (vs today)	0.7x	0.6x	0.6x
Number of electric cars sold (x) (vs 2025)	4.8	4.6	5.2
Robot taxi as % UBS EV forecasts (2025)	0%	14%	153%
ASP increase (vs today)	9%	11 %	12%
Number of robot taxis on the road (m) (2050)	204	196	220
Average number of robot taxis produced per year (m)	28	34	46

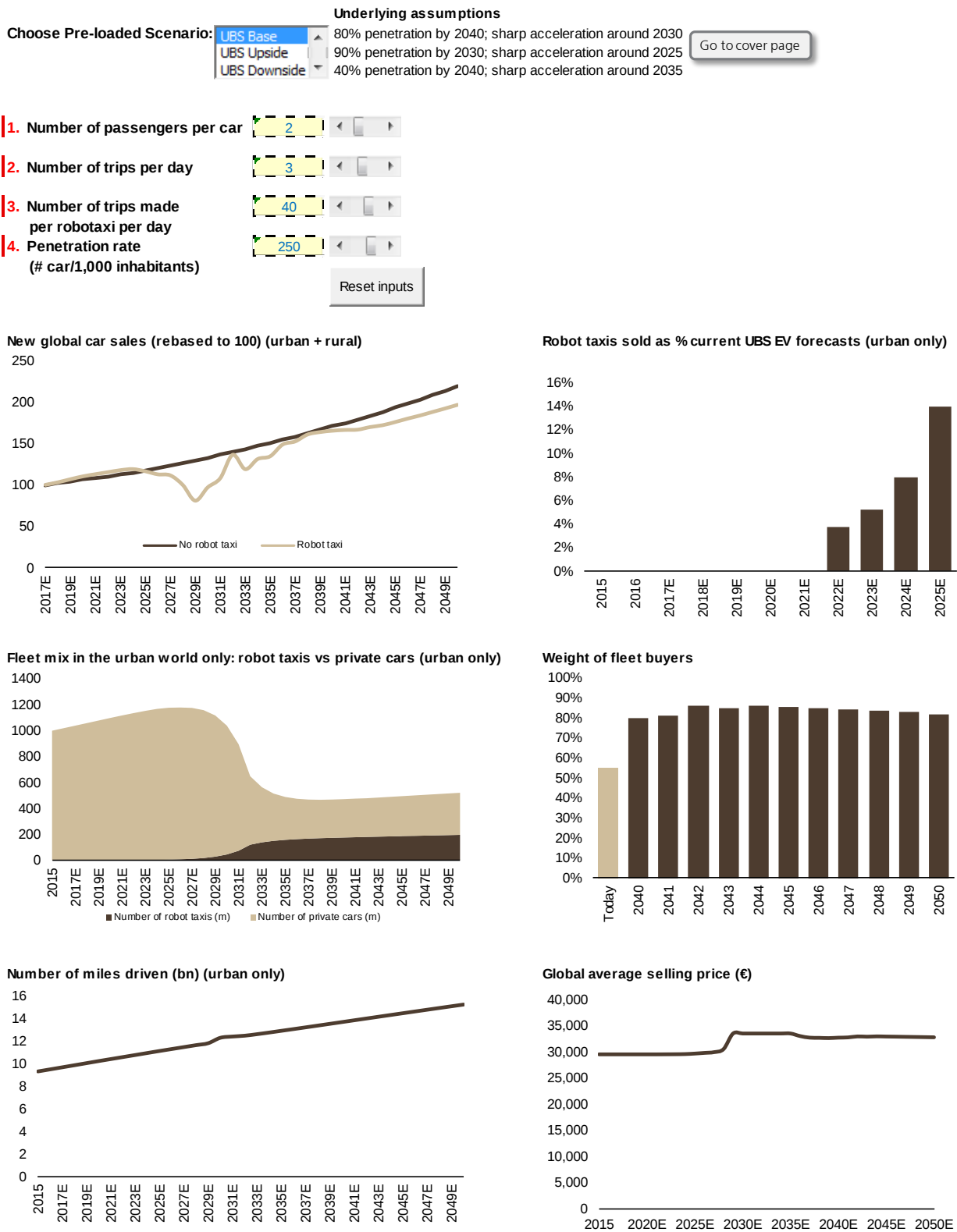
Source: UBS estimates

We have built an interactive model, shown below, which enables investors to modify scenarios and see the potential impact on the auto industry.

Figure 71: UBS interactive model - What are the implications of robotaxis for the auto industry?



What are the implications of robotaxis for the auto industry?



Source: UBS estimates

Impact 1: Lower new car sales volumes

We estimate that robotaxis could represent on average 34m units sold per year during 2016 and 2050. In the long term, we see new car sales running about 10% lower than our current estimates. However, in the medium term, new car sales will be slightly supported until 2025 and then drop as the adoption rate of robotaxis accelerates (Figure 72). Then, new car sales will recover, thanks to:

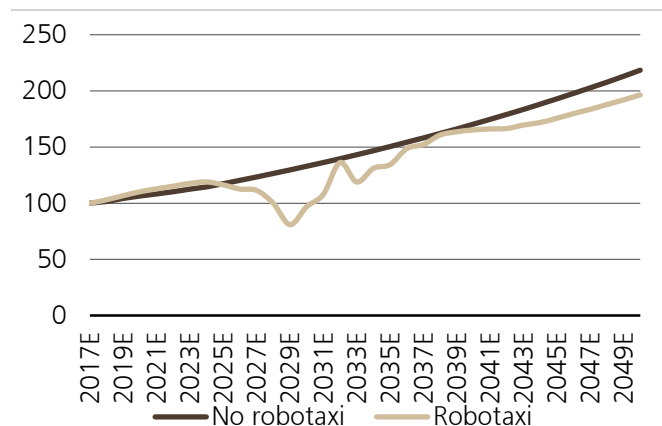
- The higher utilisation rate of the robotaxi (about 7 times higher than a private car); and
- The faster replacement velocity (in our modelling (see methodology), we assume an average life of a robotaxi of about 3 years compared to 10-12 years for a private car).

Impact 2: Faster shift towards electric cars?

As part of our [Q-Series - UBS Evidence Lab Electric Car Teardown – Disruption Ahead?](#) earlier this year, we raised our EV penetration forecast by 50% and now forecast that 14% of new cars sold in 2025 will be EV. Robotaxis will most likely be electric. Therefore, our base case suggests that 14% of the EVs sold in 2025 will be robotaxis. If the adoption rate of robotaxis were to happen earlier (see upside case), then our EV forecasts for 2025 would need to be revised upwards by at least another 50%. All in all, we forecast 196m robotaxis on the road in 2050. There will be 4x more electric vehicles produced in 2050 than 2025 (just looking at robotaxis). Robotaxis could also help stabilise the grid during peak electricity demand (if there is lower demand for transports).

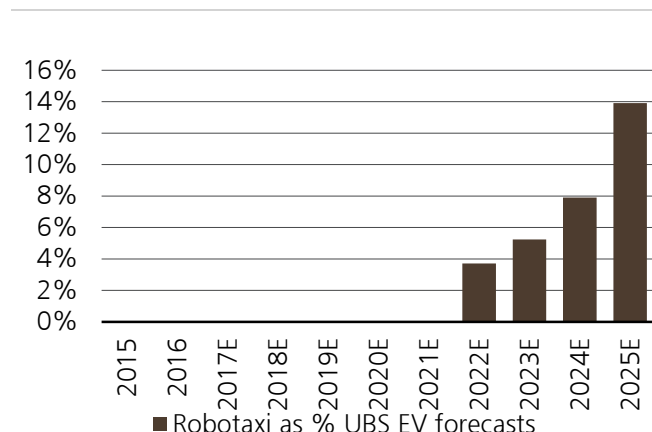
196m robotaxis on the road by 2050

Figure 72: New car sales globally (rebased to 100) – UBS base case



Source: UBS estimates, IHS Global Insight

Figure 73: Robotaxis produced as % of EV – UBS base case



Source: UBS estimates

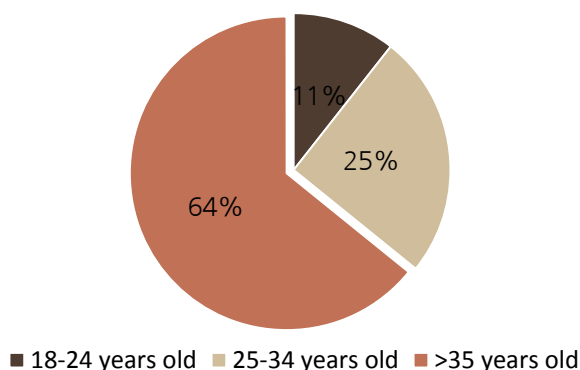
Impact 3: Demographic of new car buyers rapidly changing

Our UBS Evidence Lab consumer survey found that about 90% of prospective private car buyers are over 35 years old, and that the average age of a car buyer is 42. Interestingly, this age group is the fastest-growing cohort in ride-on-demand (see section "Are consumers ready to ride in robotaxis?")

In addition, 44% of potential car buyers have a bachelor's degree. The median household income of the car buyers in the 5 regions we have surveyed (US, China,

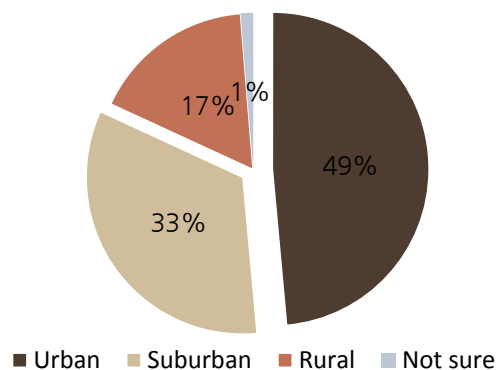
France, UK and Japan) is about €43k or ~7% higher than for those not intending to buy a car. Overall, 82% of buyers live in urban or suburban areas.

Figure 74: Average age of private car buyers



Source: UBS estimates

Figure 75: Location of private car buyers



Source: UBS estimates

The non-adopters of robotaxis are likely to be: (1) rural dwellers (<50% of the global population and shrinking) (Figure 76); 2) higher-income households, as the lower per-km cost of a robotaxi will be less relevant; (3) car enthusiasts/'petrol heads'; and (4) older people resistant to technological change.

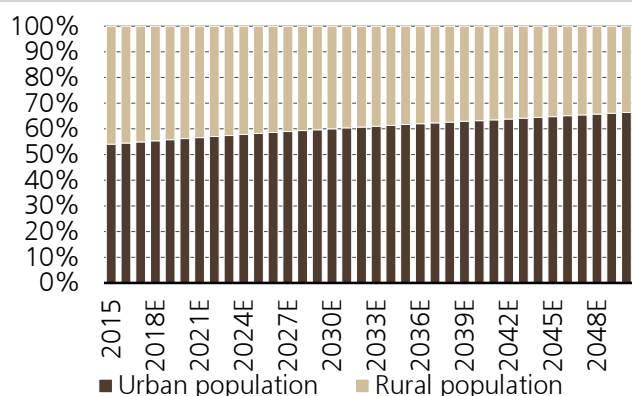
Impact 4: Providing some support to average selling prices

The average selling price of a robotaxi is likely to be slightly higher than of a traditional private car, given: (1) the higher cost of the battery (although this is coming down rapidly); (2) the higher electronics content; (3) the sensors required for autonomous features to work, and for communication with other vehicles and infrastructure (V2V and V2X); (4) the enhanced vehicle interior to maximise the user's experience.

Robotaxis should help overall pricing

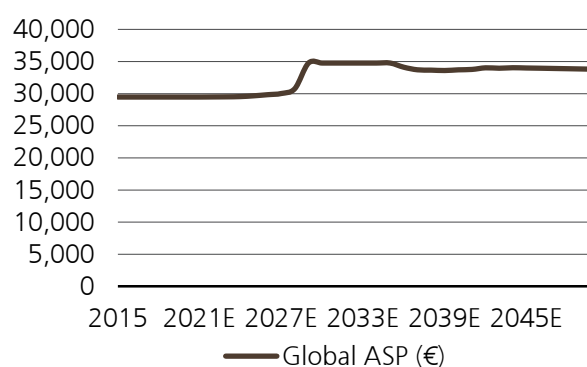
We estimate that, in our base case, the average selling price of a car will be c11% higher than today (Figure 69). However, the cars will no longer be sold to individuals as they will be managed by the OEMs, which will outsource a proportion of the production costs to external investors (see section How can OEMs reinvent themselves?).

Figure 76: Population balance, urban vs. rural



Source: UN

Figure 77: Global average selling prices (€)



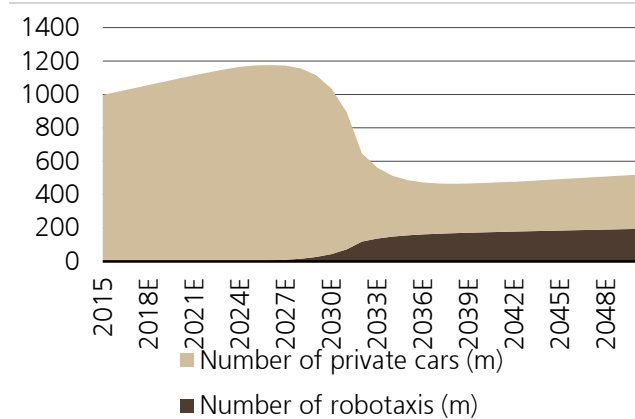
Source: UBS estimates

Impact 5: Fleet size shrinking; fleet mix changing dramatically

The shift towards robotaxi is likely to shrink the parc size by about 50% (Figure 78). In addition, the weight of fleet buyers (vs. retail customers) will increase materially. Today, we estimate that about 55% of new car sales in Europe are fleet purchases.

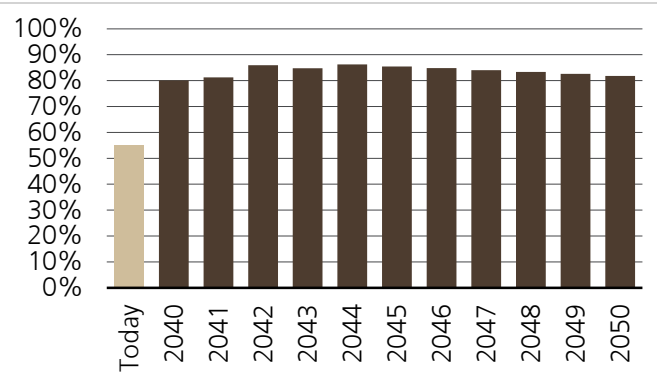
Size of the fleet will halve

Figure 78: Fleet mix: robotaxis vs. private cars



Source: UBS estimates. Note: urban only

Figure 79: Weighting of fleet buyers



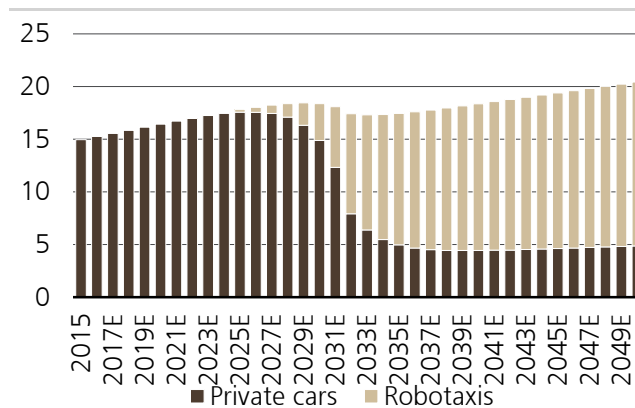
Source: UBS estimates. Note: urban only

Impact 6: Number of kilometres driven will increase

In most scenarios, the number of kilometres driven will increase, despite the shrinking car parc. The key driver is the higher utilisation rate of vehicles, since a robotaxi will be used 8 times more than a private car. On average, the number of kilometres driven per car will likely increase from 15,000/year to about 40,000/year. This should be in sync with road capacity restrictions as the size of the fleet will be halved. In addition, city infrastructure will be reshaped to accommodate robotaxis (parking spaces removed, etc.) In 2050, we estimate robotaxis will contribute 80% of the kilometres driven in the urban world.

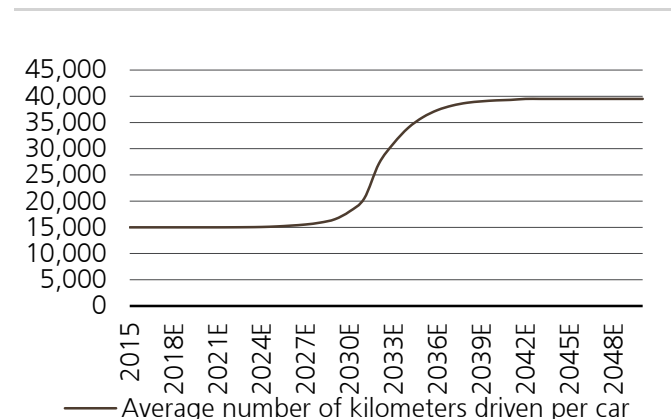
The number of kilometres driven will increase by 60%

Figure 80: Number of kilometres driven (bn)



Source: UBS estimates. Note: urban only

Figure 81: Number of kilometres driven per car



Source: UBS estimates. Note: urban only

Brand image: white labelling vs. strong differentiation potential?

As OEMs and shared mobility platforms will work together as partners, there could be a trend for an OEM to produce a car that does not feature its usual badge. In this context, we think mass makers with weak brands are most at risk. That said, features to improve the user's experience will be a means of differentiation.

OEMs could produce unbadged vehicles

Methodology

We focus exclusively on the urban world, since robotaxis are unlikely to be relevant in the rural environment. In order to gauge the number of robotaxis required, we assume each robotaxi makes 40 trips per day with two passengers in the car, and that each user makes on average three trips per day. These assumptions are consistent with the conclusions we made in our cost of km reduction potential as the shift is made towards robotaxis.

We then assume that the non-adopters of robotaxis continue to own a private car, giving us an indication on the number of private cars on the road. We assume a penetration rate of 250 cars per 1,000 people, remaining stable until 2050 (i.e. no change in ownership pattern in this population). We also assume that some private car owners will use robotaxis.

We model the replacement cycle of robotaxis and private cars in order to extrapolate the number of new vehicles sold every year. For robotaxis, we assume a third of the fleet is replaced in year 2, another third in year 3 and the final third in year 4. For private cars, we assume 1/14th of the fleet is replaced in year 2, 1/14th in year 3, etc. all the way until all have been replaced by year 15.

Finally, we assume that all robotaxis on the road are electric, that a robotaxi drives 100,000km per year (base and upside scenarios) and that a private car drives 15,000km per year.

Which players are relative winners and losers (OEMs and suppliers)?

We have screened our global OEM coverage for what we believe will be key success factors (Figure 8).

- **EV potential:** Skew to OEMs with dedicated battery electric vehicle (BEV) platforms (which we expect to pay off medium term through scale effects). Developing a dedicated EV platform will help in optimising the space inside the vehicle, improving the performance of the car and delivering a better user experience for each ride.
- **Focus on autonomous vehicles:** "First mover" vs "fast follower" strategy.
- **Focus on shared mobility/partnership with a platform:** Some OEMs are being more pro-active in terms of existing car-sharing offerings and taking equity stakes in the shared mobility platforms that help to connect supply and demand. This relationship should provide a competitive edge for those OEMs and protect their future production capacity. At the same time, the platforms will make sure there is enough competition among OEMs.
- **Finco ownership:** Fleet management experience.

We see the following factors as key for a successful transition to shared mobility for the suppliers (Figure 9):

- **Limited exposure to the "legacy" combustion powertrain business:** All legacy ICE products are likely to become irrelevant.
- **Partnership strategy in ADAS:** We favour the "partnership" strategy as opposed to the "high level of vertical integration" strategy. Today, there is not a single winning technology that enables autonomous vehicles. Suppliers are investing large amounts in R&D for some solutions that might never generate a return.
- **Strong balance sheet and cash generation:** This is mainly to fund the transformation process.

Figure 82: OEMs – potential impact of shared mobility at a glance

	EV potential	Investment focus on		Partnership w. a platform	Finco ownership
		AV	Shared mobility		
Tesla	Very high	Very high	High	No	No
Daimler	Very high	High	High	No	Yes
JLR	Very high	Medium	Medium	No	No
Volvo (Geely)	Very high	High	Low	No	No
BMW	Very high	High	High	No	Yes
VW	High	High	High	Yes	Yes
Renault	High	Low	Medium	No	Yes
Nissan	High	High	Medium	No	Yes
Toyota	High	High	High	Yes	Yes
PSA	High	Low	Low	No	No
Ford	High	High	High	Yes	Yes
GM	High	High	High	Yes	Yes
Mazda	Medium	Medium	Low	No	No
Honda	Low	High	Medium	No	Yes
FCA	Low	Low	Medium	No	No
Subaru	Low	Medium	Low	No	No
Suzuki	Low	Low	Low	No	No

Source: UBS estimates

Figure 83: Suppliers – potential impact of shared mobility at a glance

	Share of revenues related to		Balance sh. strength*	FCF generation**
	ICE Powertrain	ADAS / autonomous vehicles		
Autoliv	0%	7%	0.1x	3.7%
Continental	19%	23%	0.3x	5.4%
Faurecia	40%	31%	0.2x	0.3%
GKN	41%	0%	0.7x	7.4%
Gestamp	0%	0%	1.8x	0.3%
Hella	1%	4%	0.3x	3.0%
Michelin	0%	0%	0.2x	7.8%
Nokian	0%	0%	-0.7x	3.3%
Schaeffler	50%	0%	1.1x	7.1%
Valeo	25%	20%	0.6x	3.5%
BWA	62%		1.0x	5.3%
Delphi	35%		1.0x	6.1%
Lear	0%		0.3x	8.4%
Magna	15%		0.6x	8.1%
Tenneco	70%		1.2x	8.6%
Visteon	0%		-1.2x	3.2%
Aisin Seiki	56%	1%	-0.5x	5.1%
Denso	35%	3%	-1.0x	3.8%

Source: UBS estimates

Tire makers: key beneficiaries of the shift towards robotaxis

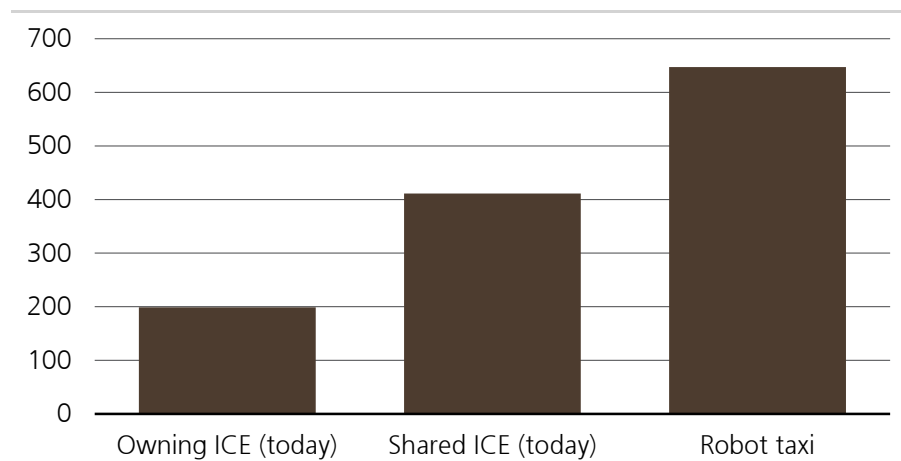
The only items that wear out faster in an EV are the tires, due to the vehicle's higher curb weight and greater torque. In our example, we assume that tires wear out 22% faster due to the 22% difference in the curb weight between the Bolt and the Golf. This represents an opportunity for tire makers. However, as energy density in batteries keeps rising (and battery weight per kWh keeps coming down), the difference in curb weight might gradually disappear in the long run.

Since the weight of fleet buyers is increasing, pricing is likely to come under pressure. However, fleet buyers are more focused on the total cost of ownership and could consider better quality tires that can last longer. Therefore, this should be positive for the mix.

The annual cost of tires fitted on a robotaxi will be about 5 times higher than in a private car, including the higher utilisation rate of the vehicle and the higher curb weight.

The annual cost of tires is 5x higher on a robotaxi

Figure 84: Annual cost of tires (€)



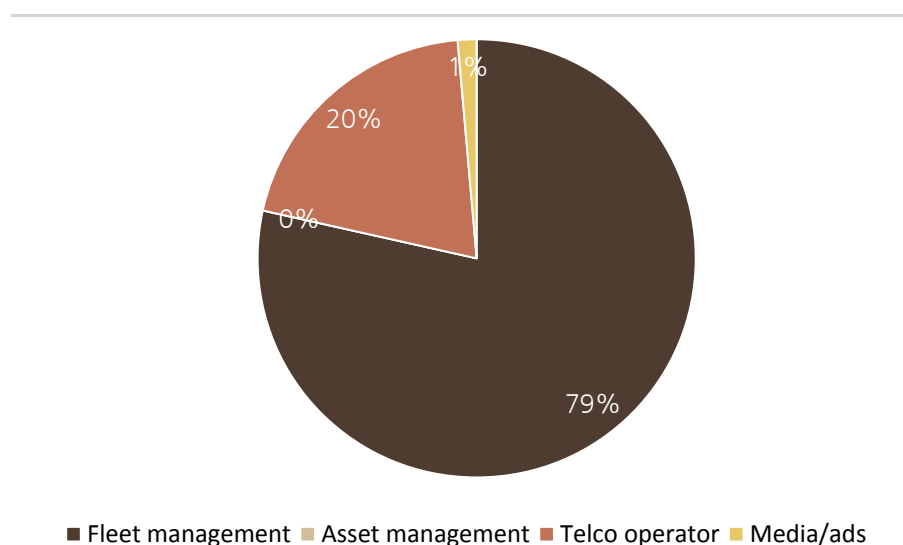
Source: UBS estimates

How could the auto industry reinvent itself?

It is widely assumed that the shift toward the "car of the future" will be highly disruptive and negative for the auto industry, and the OEMs in particular. A key question we seek to answer in this section is whether OEMs will be significant players in the "mobility as a service" world, and whether they will ever be able to make money in the space. We think OEMs will have to reinvent their business model and expand their offering to other segments. The shift towards robotaxis could represent an opportunity to improve returns slightly and generate less cyclical revenue streams (Figure 85). A more stable earnings stream through services/subscriptions could trade on much higher multiples than selling the hardware today.

A more stable earnings stream through services/subscriptions could trade on much higher multiples than selling the hardware today

Figure 85: "Car of the future" – new revenue streams



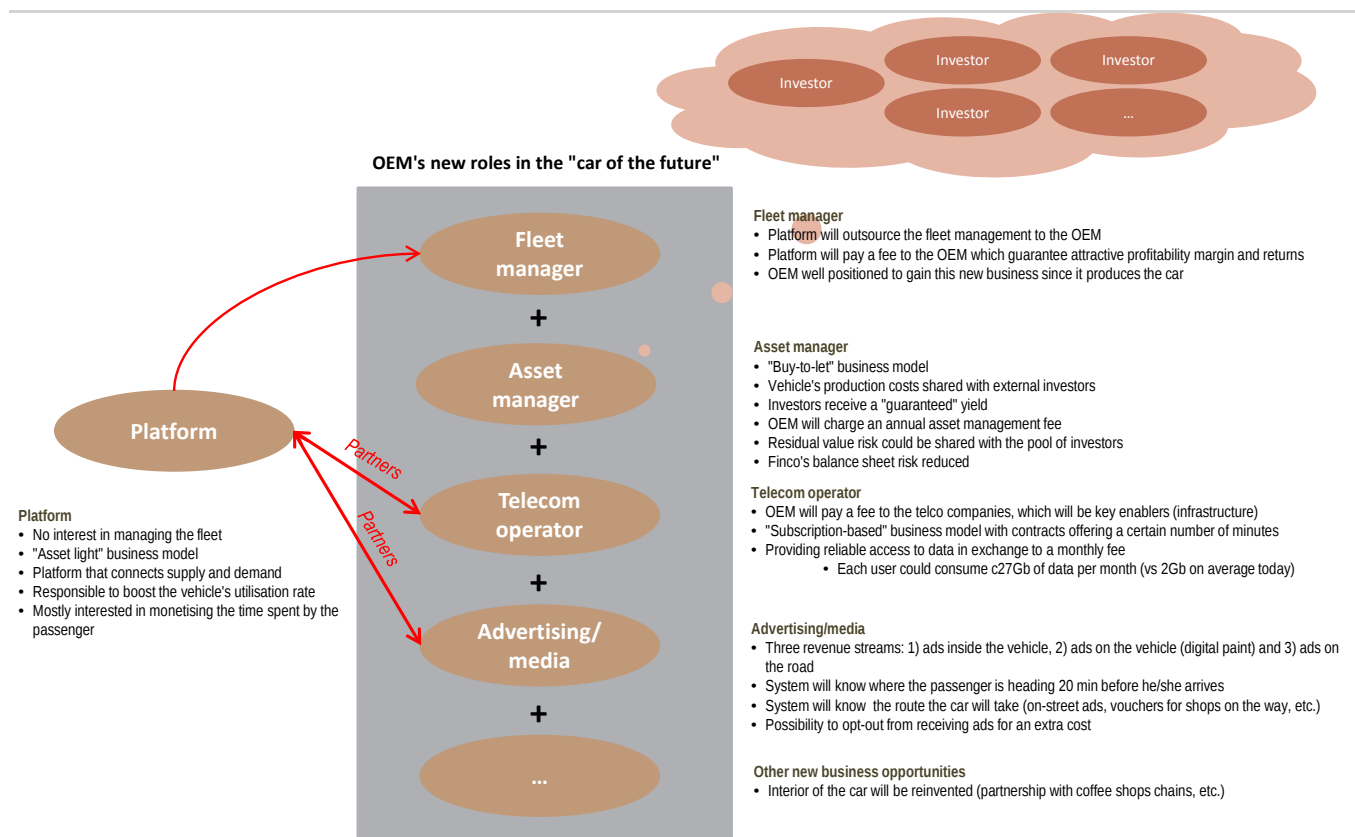
Source: UBS estimates

Figure 86 depicts how this new paradigm could look like for the different stakeholders. We see the shared mobility platforms and the OEMs as partners. Platforms have no interest in producing cars (recent media articles suggest that the launch of an Apple car has been pushed back to after 2020, and that Apple will for now remain focused on the software) and would rather outsource ownership of the cars in order to keep the business model as asset-light as possible.

We see OEMs and platforms acting as partners

In this new paradigm, we think OEMs will expand their role into other areas such as fleet management, asset management, telecoms and advertising/media.

Figure 86: OEMs' role in the "car of the future"



Source: UBS

Generating revenues from fleet managers

How would this work?

As stated above, the platform has no interest in producing cars or managing the fleet, as it requires too much capital. Therefore, it will seek partnerships with either carmakers or rental companies, and will pay a fee for the management of the fleet. As producers of the vehicles, OEMs are likely to be well positioned to win this business. The required fee will have to be high enough to guarantee both an attractive profitability margin and returns for the OEM.

The OEMs' fincos are already involved in fleet management and likely to move from leasing/renting traditional ICE vehicles to owning fleets of robotaxis.

What are the financial implications?

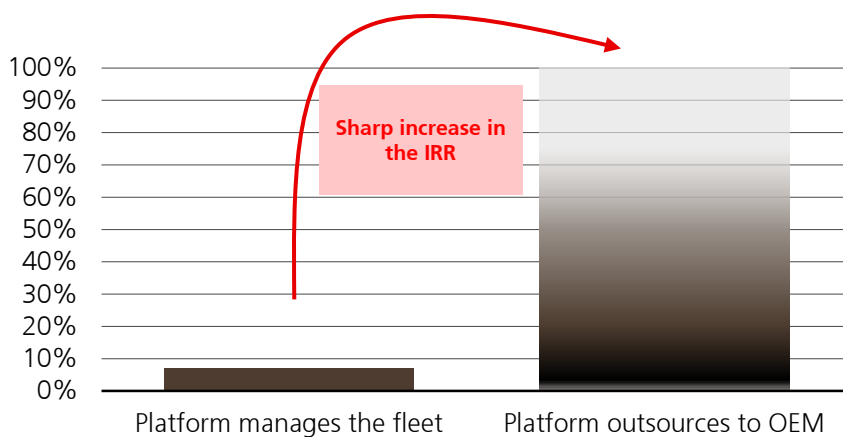
- **From the platform's viewpoint:** As discussed earlier, we estimate that the annual revenue potential of a robotaxi will be €29k, and the annual gross profit could be as high as €11k, assuming the platform bears the annual costs (operating and financing). If the platform fully outsources the ownership of the car, it no longer has to cover the vehicle's related costs. The annual gross profit could be meaningfully reduced, but the returns would be materially higher (Figure 87). The weight of revenue kept by the operator would be equivalent to the c25% commission paid to the driver today.

The platform has no interest in producing cars

OEM fincos could move from leasing/renting traditional ICE vehicles to owning fleets of robotaxis

Platform will pay a fee to the OEM to outsource the fleet management

Figure 87: Platform's returns – insourcing vs outsourcing the fleet management



Source: UBS estimates

- **From the car maker's viewpoint:** The car maker will require two things: (1) a gross margin which is higher than the one generated by producing the robotaxi; and (2) higher returns than the cost of capital. This would be margin-accretive for the OEM in comparison to a c20% gross margin generated on average on producing the vehicle. Another benefit includes the ability for the OEM to use its owned dealership for the servicing of the cars and better cover the related costs.

Fleet management could be margin-accretive for the OEM

Today, we estimate that in Europe about 55% of new cars are purchased by corporate fleets. In a "shared mobility" world, most of the cars will be purchased by fleet managers or be kept on the OEM's books. Therefore, private car purchases will likely be limited to rural households, "petrol heads" and high-income purchasers. The traditional fleet buyers are likely to be under pressure as OEMs take over.

Recent newsflow suggests that car rental companies may be interested to compete with OEMs for the fleet sharing opportunity. According to a Bloomberg report, Apple agreed to lease several Lexus SUVs from Hertz for the purpose of testing its autonomous driving technology. This news mirrors an agreement between Alphabet's self-driving car unit Waymo and the Avis Budget Group, under which Avis will manage and store Waymo's Chrysler Pacifica minivans for a fee. In this case, the vehicles will continue to be owned by Waymo.

Car rental or OEM: who will win the fleet management business?

Generating revenues from physical asset management

How would this work?

The OEM will finance part of the vehicle's production cost by bringing in external investors. The capital will be brought by a pool of investors, which will receive a "guaranteed" annual yield and also pay an annual asset management fee. This product would be similar to an asset-backed security. The interest between the investors, the OEM and the platform will be fairly well aligned, reducing the risk of disintermediation.

"Buy-to-let" business model

On our estimates, the investors could expect an IRR of around 9% (pre-tax, net of asset management fee) for a very low cost of risk, given the scope to diversify the portfolio and the relatively low value of the initial investment and the collateral. We could imagine that the investors' funds are split by geography, vehicle type and platform. Our analysis does not include a potential performance fee should some specific thresholds be met.

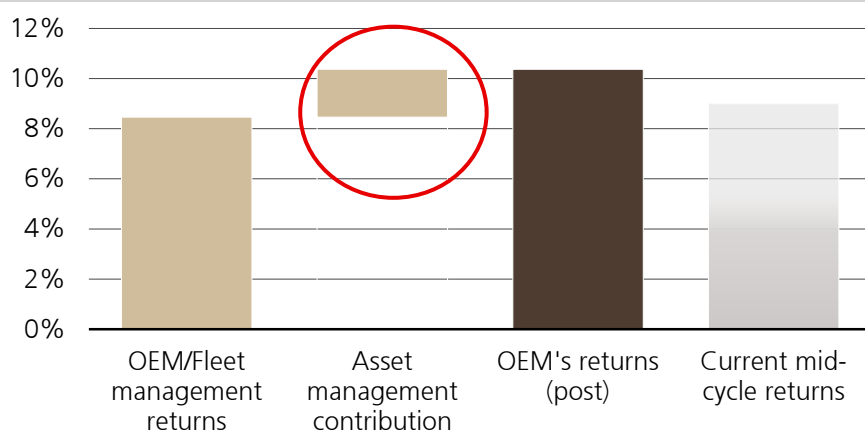
What are the financial implications?

Through the cycle, OEMs barely return their cost of capital. By bringing outside investors to finance part of the production of the vehicle, the asset management activity could improve the OEM's return by about 1-2 percentage points.

Vehicle could become an asset generating a yield

Asset management activity could boost the OEM's returns by about 1-2 percentage points

Figure 88: Asset management contribution to OEM's returns



Source: UBS estimates

We assume that 25% of the vehicle's production cost is financed by a pool of 20 investors. Given the fees received from managing the fleet of robotaxis, the OEM can guarantee a yield of about 25%. During the life of the vehicle, the OEM will receive an annual asset management fee of 50 bps. We show sensitivities to our key assumptions in the table below.

Figure 89: Returns generated by OEM from management activity

		Vehicle's production cost covered by investors				
		10%	25%	50%	75%	100%
Yield paid to investors	5%	12%	19%	39%	98%	nm
	10%	11%	17%	34%	82%	nm
	15%	11%	15%	28%	65%	nm
	20%	10%	13%	22%	48%	nm
	25%	9%	11%	16%	31%	nm
	30%	9%	9%	10%	14%	nm

Source: UBS. Note: assumes an annual asset management fee of 50bps

Another key benefit for the OEM could be the scope to reduce its residual value risk, as it is shared with a pool of investors. At the end of the life, the robotaxi could be shipped to emerging markets/rural regions, or even sold to retail customers. The EV battery can still be used for stationary appliances. A solar energy system on a residential rooftop doesn't require a battery larger than 10kWh, which is only a fraction of the capacity of EV batteries.

Generating revenues from telecom operators

How would this work?

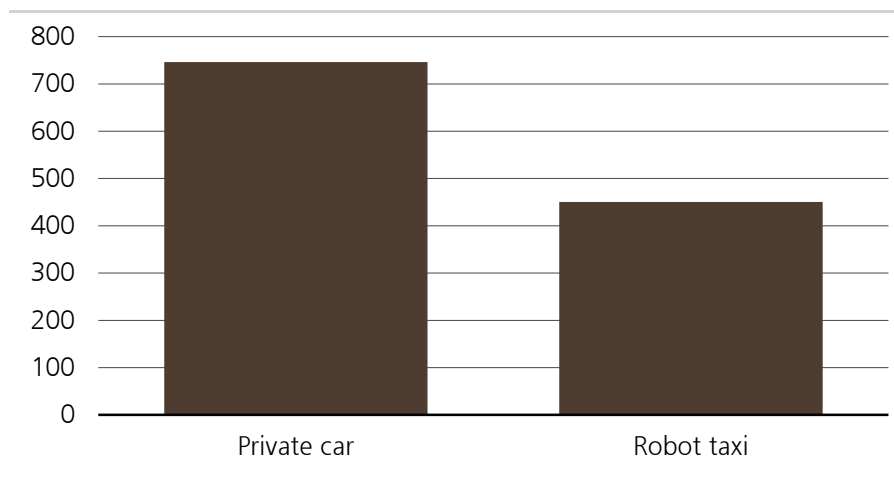
The traditional telco operators will be key enablers as they will develop the infrastructure required for autonomous vehicles to work. The network will have to be upgraded to 5G, which requires higher density for cell sites than 4G.

The OEM will compensate the telco operators by increasing the fee charged to the user. We see two potential revenue streams that will be shared between the OEM and the platform: (1) a monthly subscription fee, which enables the user's loyalty rate to be increased; and (2) reliable and stable access to data. We see the platform as a partner and assume revenues will be shared on a 50/50 basis.

There is a risk that some OEMs may just give away everything for free, given the level of competition. Indeed, the OEMs are today much more fragmented than the platforms.

- **Monthly contract fee:** Assuming a similar number of kilometres driven as in a private car today, we estimate that each user will spend on average €400 per month to travel in a robotaxi. This is still just over half the cost of owning a car (Figure 90) and equivalent to a fee of 13 cents per travelling minute.

Figure 90: Monthly cost – car ownership versus robotaxi (€)



Source: UBS estimates

In order to improve the loyalty rate, OEMs could offer a discounted price for a certain number of minutes per month, which gives access only to the fleet of vehicles they manage. Minutes spent outside the contract or minutes spent abroad (equivalent to roaming) would be charged at an extra cost.

- **Reliable access to data:** While in the car, users will most likely be using their smartphone to watch movies, work, etc. The interior will be shaped in ways that can facilitate and optimise the user's experience. The OEM could provide reliable access to data (wifi hotspots; download functionality in tunnels/narrow streets, etc.) and charge a fee. It would also include unlimited video/music streaming and computer access using the hardware already available in the car. We estimate each user will consume 27Gb of data per month, compared to an average of 2Gb/month today.

What are the financial implications?

Telco operators as key enablers

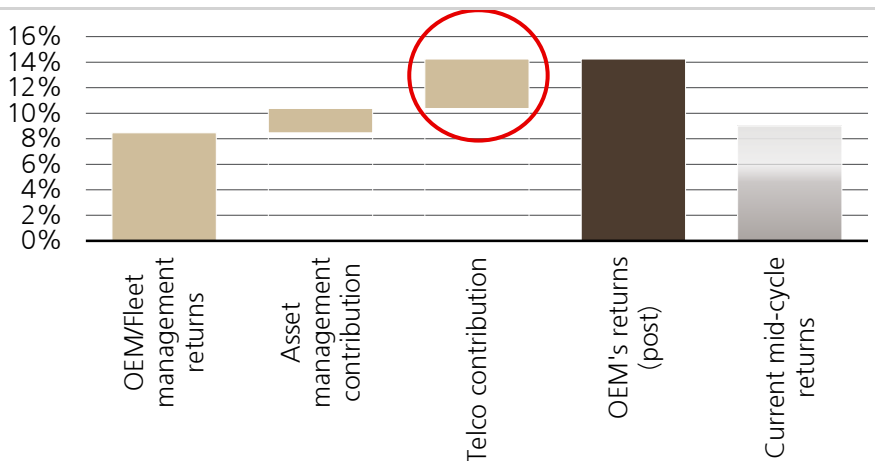
Two revenue streams: monthly contract fee and data access

Improving loyalty rate

The amount of data consumed in a robotaxi will be 15x higher than today's average for each subscriber

On our maths, each user will spend about 116 minutes per day in the robotaxi, equivalent to 40 hours per month. Assuming this entire period is spent downloading/uploading data, we estimate the revenue generated per user and per month could be as high as €27. The data-related revenue per car (assuming 20 trips per day) would amount to €6-7k per year, which should be split equally between the platform and the OEM. The platform will be in charge of connecting demand with supply, and the OEM will be in charge of installing the hardware and managing the fleet.

Figure 91: Returns generated by OEM from telco services



Source: UBS estimates

Generating revenues from advertising/media companies

How would this work?

The time we are spending in cars will structurally go up in the future, for two key reasons: (1) shift from public transport towards robotaxis and; (2) the lower cost of using a robotaxi vs. owning a car. We think the OEM and the platform will share the advertising revenues, which will come from: (1) ads inside the vehicle; (2) ads on the vehicle (digital paint); and (3) ads on the road. This could represent an opportunity to sell media and highly valuable selective advertising. Today, the transport authorities receive the fees related to the ads you see inside trains or buses.

- **Ads inside the vehicle:** With GPS data and consumer profiling, there will likely be significant value in directly marketing to people through push-notifications on navigation and/or infotainment systems and/or on-board entertainment. We estimate that the average person will spend on average almost two hours per day in the car. Rather than spending on untargeted marketing campaigns, the car maker could monetise this captive audience for commercial ads. The user will be able to opt-out from receiving ads and, as such will pay a monthly fee.
- **Ads on the car:** The body structure of the car could be designed to integrate ads that will change depending on the area where the car is located, time of the day, etc.

Time spent in cars will structurally increase

Selective marketing to a captive audience

"Digital paint"

- **Ads on the road:** The operator/platform and the OEM will know where the user is going about 20-30 minutes before arrival and, more importantly, will know the path the vehicle will take. There will be ways to design the trip in order to maximise the revenue generated by companies willing to pay to show ads.

What are the financial implications?

We assume that the revenues generated by the ads inside the car will be similar to the ad revenue coming from a mobile phone, since most people are likely to use their smartphone while they are being driven in the robotaxi. The weight of mobile ads revenue could increase from 9% today to 50% of global ad revenue by 2030. The ad revenue per mobile phone could be as high as \$80 per year. Since each user will spend about 2 hours per day in the car, this would translate into annual revenues of \$7 per passenger. Each robotaxi will do 20 trips per day. Therefore, the ads inside the car could contribute about \$166 per year per robotaxi. We also estimate that 50% of users will decide to opt-out from receiving ads, at a cost of €50 per month.

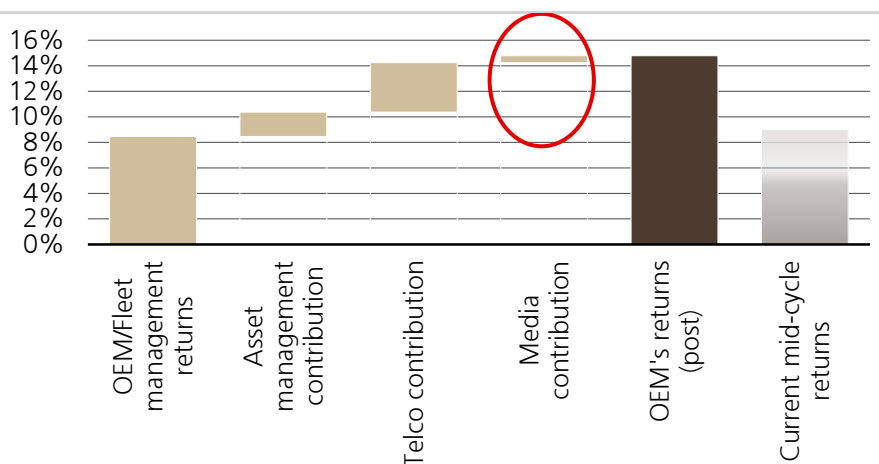
Outdoor ads currently represent 3% of global ad revenue and have been growing at an annual rate of 8% since 2008. Assuming similar growth going forward, revenues could amount to \$100bn in 2030. Since 60% of the world's population will be urban and transport will represent about 20% of outside ad revenue, we estimate that the revenue potential for robotaxis could be \$12bn, or \$274 per robotaxi.

Finally, ads on the exterior of buses (static) are sold at between \$150 and \$600 for a four-week period (source: bluelinemedia). On that basis, we estimate the revenue potential to be close to \$5,000 per robotaxi.

OEMs will provide the space for the ads and will rent it. As with the data, the revenues will be shared with the platform. We estimate that the OEM could capture about €400-500 per robotaxi.

€500 revenue opportunity per robotaxi

Figure 92: Media contribution to the OEM's returns



Source: UBS estimates

OEM and platform will work as partners

The automakers have expertise in making cars and are strategically positioned—they control access to the car's data. On the other hand, tech companies have the data analytics and software skills needed to develop connected applications, and compelling technology offerings could strengthen their positioning. In addition, they will be responsible for connecting supply versus demand, and the platform provides the operating system.

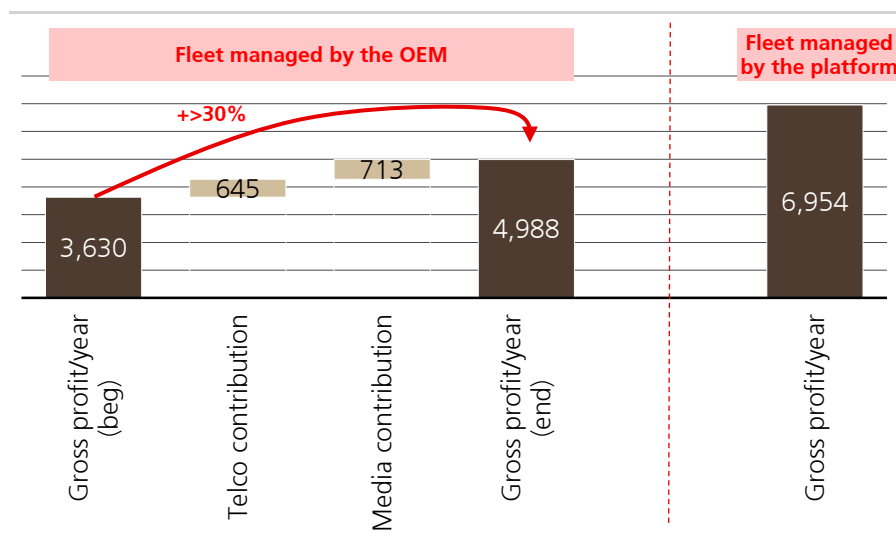
We think OEMs and tech companies will work as partners since they will both benefit from the shift towards robotaxis. Tech companies have no interest in making cars and managing the fleet since it is too capital-intensive. OEMs will be responsible for managing the fleet and designing the vehicle's interior in order to maximise the user's experience.

In Figure 93, we show the gross profit per year generated by the platform. It would meaningfully increase if the fleet management was to be outsourced to the OEM (despite the lower gross profit). In addition, the platform will benefit from the partnership with the OEM and will be able to increase its gross profit by almost 30% thanks to the contribution from data and ads.

Both OEMs and platforms will benefit from working together

Platform's gross profit boosted by 30%

Figure 93: Gross profit per year for the platform (€/vehicle)



Source: UBS estimates

What are the implications for other sectors?

Shared mobility will have a strong fundamental impact on many sectors. UBS global sector teams have contributed their analysis, highlighting the stocks most positively or negatively exposed.

Figure 94: Sector map – impact of shared mobility at a glance

Shared mobility	Revenue					Shared mobility	Revenue				
Impact on ...	growth	EBIT margin	ROIC	Valuation		Impact on ...	growth	EBIT margin	ROIC	Valuation	
Auto OEMs						Chemicals					
Auto suppliers						Capital goods					
Battery producers						Oil					
Semi-conductors						Steel					
Utilities											
Tech											

Source: UBS estimates

Figure 95: Stock positively and negatively impacted by the theme

Positively impacted			Negatively impacted		
	Rating	PT (Icl)		Rating	PT (Icl)
Daimler	Buy	85	PSA	Neutral	18
VW	Buy	180	FCA	Neutral	13.4
Michelin	Buy	129	Schaeffler	Sell	10
Valeo	Buy	82	Autoliv	Sell	87
Conti	Buy	230	United Utilities	Sell	825
LG Chem	Buy	375,000	Severn Trent	Sell	2090
Samsung SDI	Buy	240,000	Seagate	Sell	28
Infineon	Buy	21	Johnson Matthey	Sell	2650
Texas Instruments	Buy	93	EMS-Chemie	Sell	450
Fortum	Buy	16.1	SKF	Sell	140
EDF	Neutral	8.6	Sandvik	Sell	110
Flex	Buy	18	Admiral	Neutral	2050
Umicore	Buy	75	Allstate	Neutral	93
Siemens	Buy	131			
Allianz	Buy	200			
ArcelorMittal	Neutral	21.5			

Source: UBS estimates

Global OEMs

Robotaxis –
impact on sector ...

Growth:



Margins:



ROIC:



Valuation:



PIVOTAL QUESTIONS

Q: What are the implications of a shift towards robotaxis?

Carmakers will likely have to reinvent their business model and expand into new areas such as fleet management, asset management, telecoms and media. The penetration of electric cars should be boosted.

Q: Does the shift in the OEMs' business model represent an opportunity or a threat?

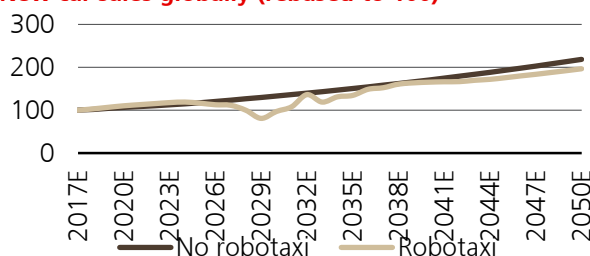
MIXED. A few winners; many losers. Positives: Less-cyclical revenue streams, and a more asset-light business model. Negatives: Sharp reduction in the penetration rate of private cars; OEMs with low brand equity potentially becoming irrelevant, lower barriers to entry.

FINANCIAL IMPACT

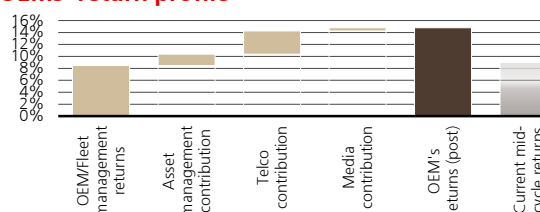
Q: What will be the financial impact on the industry?

Once the asset base is adjusted, OEMs' returns could improve slightly as they gain exposure to new segments. In the long run, new car sales are likely to run c10% below trend.

New car sales globally (rebased to 100)



OEMs' return profile



Source: UBS estimates

Source: UBS estimates

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption by robotaxis?

NO. Managing the transition could be a challenge: OEMs are "supertankers" and changing direction may be an enormous challenge for management teams. OEMs would need to accelerate investments in EVs and autonomous vehicles. Only a few have developed partnerships with shared mobility platforms. The mindset needs to change from "selling a car" to "monetizing the user's experience".

SECTOR VALUATION

Q: Could the trend towards robotaxis lead to a change in sector valuation multiples?

YES. Current valuations are running 20% below through-the-cycle multiples. Less-cyclical revenue streams and slightly higher returns could merit a higher multiple. OEMs will likely need to write off their asset base first.

STOCK IMPACT

Q: What stocks will be impacted most positively and negatively?

MOST FAVORED

Stock	UBS rating	2018E PE	Comment
Daimler	BUY	7.3x	Premium OEM most active in shared mobility
VW	BUY	5.3x	Active in shared mobility; took equity stake in Gett

LEAST FAVORED

Stock	UBS rating	2018E PE	Comment
PSA	Neutral	10.5x	Low brand equity
FCA	Neutral	5.6x	Fast follower strategy

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Global auto suppliers

Robotaxis –
impact on sector ... **Growth:**



Margins:



ROIC:



Valuation:



PIVOTAL QUESTIONS

Q: What are the implications of a shift towards robotaxis?

The manufacturing process would be more standardized. The electronic/software content for suppliers would sharply increase. Highly profitable aftermarket revenues would collapse. The number of kilometres driven would increase by 60%. The interior of the car should be a key differentiating factor for OEMs.

Q: Does the shift in the OEMs' business model represent an opportunity or a threat?

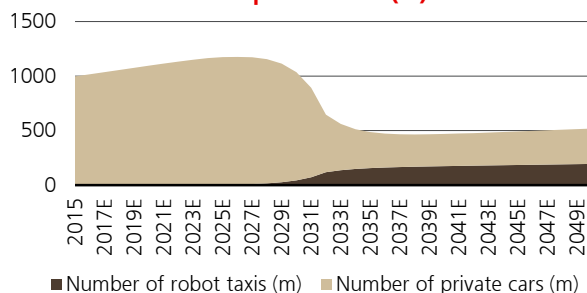
MIXED. Positives: Higher content value should drive organic growth. Negatives: Lower new car sales; lower barriers to entry with new entrants competing; lower aftermarket revenues despite higher utilization rates, driven by (1) car parc size halving and (2) fewer moving parts in electric cars; more pricing pressure on traditional products.

FINANCIAL IMPACT

Q: What will be the financial impact on the industry?

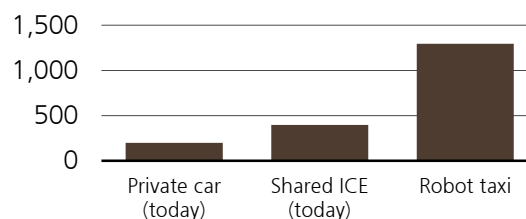
The content for the suppliers in an electric-autonomous car is about 3-5x higher than for an ICE. A higher number of kilometres driven, combined with a higher weight of fleet buyers (more TCO aware), should benefit tire makers despite the shrinking fleet. The yearly spend on tires increases by a multiple of 5 in a robotaxi.

Fleet mix: Robotaxi vs private cars (m)



Source: UBS estimates

Annual spend on tires (€)



Source: UBS estimates

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption from robotaxis?

NO. Suppliers are better positioned than OEMs to benefit from the key auto megatrends. However, the industry could underestimate to what extent the intensifying competition could be a drag on profitability.

SECTOR VALUATION

Q: Could the trend towards robotaxis lead to a change in sector valuation multiples?

MIXED. Suppliers are currently trading at a slight premium to their mid-cycle multiples and at a large premium to OEMs. Suppliers exposed to the key auto megatrends with flexible strategies should merit higher multiples.

STOCK IMPACT

Q: What stocks will be impacted most positively and negatively?

MOST FAVORED

Stock	UBS rating	2018E PE	Comment
Michelin	BUY	11.3x	Benefiting from the higher number of kilometres driven
Valeo	BUY	13.9x	Strong potential of Siemens JV for EVs and leader in ADAS
Conti	BUY	12.1x	Tire exposure and software / sensor / EV-powertrain supplier

LEAST FAVORED

Stock	UBS rating	2018E PE	Comment
Schaeffler	SELL	7.7x	Legacy product portfolio and high aftermarket exposure
Autoliv	SELL	19.5x	Passive safety product portfolio at risk; catching up in ADAS

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Electric Vehicle Batteries

Robotaxis –
impact on sector ...

Growth:



Margins:



ROIC:



Valuation:



PIVOTAL QUESTIONS

Q: What are the implications of a shift towards robotaxis?

Robotaxis would accelerate EV penetration and spark a sharp increase in the number of kilometres driven globally. Both of these trends will drive increased electric battery demand and this should be a positive for incumbent battery producers. Given the autonomous nature of robotaxis, safety and track record on the battery side will be even more important. This will heavily favor incumbent players and drive better-than-expected profitability.

Q: Does the shift in the OEMs' business model represent an opportunity or a threat?

We believe global battery producers will experience a period of up-cycle profitability as we move towards 2025. For the next 10 years, we think the incumbents (LG Chemical and Samsung SDI) will take the lion's share of EV vehicle battery market share outside China. Additionally, LG Group has 56% of the Chevy Bolt's content. We believe incumbents could have the financial strength and expertise to become robot vehicle investors/producers.

FINANCIAL IMPACT

Q: What will be the financial impact on the industry?

Better-than-expected profitability could move OPM for EV battery producers to c10% by 2025. This is above our previous forecast of 6%. Taking LG Chemical as an example, this would move our 2025E EBIT assumption from US\$750m to US\$1.2bn.

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption from robotaxis?

With 12 months required from final investment decision to battery production, capex and capacity is highly scalable. We believe the industry is well positioned from a demand perspective. However, with longer driving distances the industry will need to address battery life-cycle issues (currently 7-8 years), increase driving distance per charge (currently c320km) and further reduce charge times (currently about one hour).

SECTOR VALUATION

Q: Could the trend to robotaxis lead to a change in sector valuation multiples?

We believe the EV battery divisions for Korean conglomerates are being valued at less than 2x P/B. As we move closer to the break-even point for batteries and see further evidence of mass-market adoption, we firmly believe we could see a significant re-rating.

STOCK IMPACT

Q: What stocks will be impacted most positively and negatively?

MOST FAVORED

Stock	UBS rating	2018E PE	Comment
LG Chemical	BUY	12.6x	Up-cycle petrochemical cash flows give LG Chemical further financial potential to invest in robot vehicle production
Samsung SDI	BUY	13.3x	We see positive momentum across all its divisions, with EV battery to break-even in 2H18

LEAST FAVORED

Stock	UBS rating	2018E PE	Comment
NA			

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Global Semiconductors

Robotaxis –
impact on sector ... **Growth:**



Margins:



ROIC:



Valuation:



PIVOTAL QUESTIONS

Q: What are the implications of a shift towards robotaxis?

The shift towards robotaxis should be a positive for content growth for semiconductor suppliers as it accelerates the two key content drivers. The trend towards EVs, we believe, will increase the drivetrain semiconductor content to \$580 from the \$60-90 in an ICE car, with the main beneficiaries being power semiconductor suppliers. An acceleration in the adoption of autonomous vehicles (Level 4/5) would boost the ADAS content opportunity: we believe the uplift could be as high as \$650-1,400 of semi content, depending on the system architecture.

Q: Does the shift in the OEMs' business model represent an opportunity or a threat?

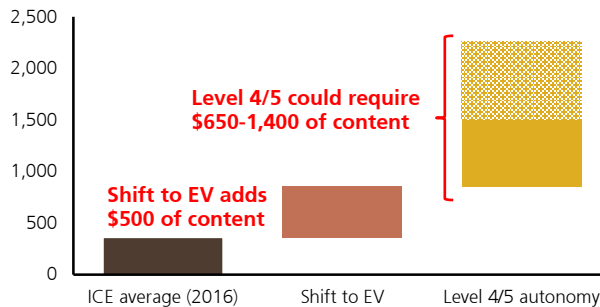
OPPORTUNITY. Positives: Supports the content growth acceleration we already expect from EV/ADAS; greater use of infotainment/advertising could also drive up content; OEMs likely to increasingly work directly/closely with semi content suppliers. Negatives: 10% lower new car sales in the medium term could dampen growth.

FINANCIAL IMPACT

Q: What will be the financial impact on the industry?

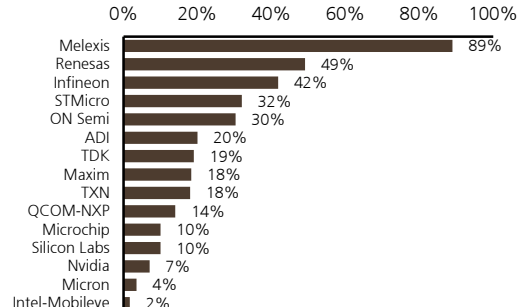
The content uplift in electric-autonomous car for semiconductor suppliers could be as much as 4-6x higher than for an ICE car today. This will likely add further momentum to the content story we already expect.

Semiconductor content in EV/autonomous cars (\$)



Source: UBS estimates

Autos exposure by semi company (% of sales)



Source: UBS estimates, company data

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption from robotaxis?

YES. The industry is investing heavily today, as semis are critical to enabling the robotaxi of the future.

SECTOR VALUATION

Q: Could the trend towards robotaxis lead to a change in sector valuation multiples?

MIXED. Semiconductor companies exposed to autos have already seen notable multiple expansion and are trading at an all-time high premium to suppliers/OEMs.

STOCK IMPACT

Q: What stocks will be impacted most positively and negatively?

Most of the sector should be positively impacted by the trend; we highlight our preferred names below.

MOST FAVORED

Stock	UBS rating	2018E PE	Comment
Infineon	BUY	20.2x	Greatest beneficiary of rising EV penetration
Texas Instruments	BUY	20.6x	Rising exposure to autos, including infotainment and power management
TSMC	BUY	14x	Leading foundry – beneficiary of rising logic compute for ADAS

LEAST FAVORED

Stock	UBS rating	2018E PE	Comment
Melexis	SELL	26x	Benefit from ADAS but not from electrification – most expensive
STMicro	SELL	19.5x	Solid autos exposure, but we have concerns on other parts of group

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IT Hardware & EMS



PIVOTAL QUESTIONS

Q: What are the implications of a shift towards robotaxis?

We see little impact on the enterprise IT Hardware sector, which will not likely be supplying components or systems to robotaxis. We do see a positive impact on the Electronic Manufacturing Services (EMS) companies, such as Flex and Jabil. Flex has a \$3bn automotive business providing electronics for headlights to actuators on mirrors. Robotaxis should increase electrification in cars, enabling EMS companies to capture incremental total addressable market.

Q: Does the shift in the OEMs' business model represent an opportunity or a threat?

Neither a threat nor an opportunity for enterprise IT Hardware, but positive for EMS.

FINANCIAL IMPACT

Q: What will be the financial impact on the industry?

Positive impact on EMS.

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption from robotaxis?

The industry has started addressing autonomous vehicles. If the car designers are ready, the EMS names should be ready to implement. Flex has recently made key automotive hires from Tier 1 suppliers like Delphi. Jabil is more of an up-and-comer with its smaller auto business.

SECTOR VALUATION

Q: Could the trend to robotaxis lead to a change in sector valuation multiples?

Possibly as part of the growth story for EMS.

STOCK IMPACT

Q: What stocks will be impacted most positively and negatively?

MOST FAVORED

Stock	UBS rating	2018E PE	Comment
Flex	BUY	15.4x	Flex has an established auto team and relationships with several auto manufacturers

LEAST FAVORED

Stock	UBS rating	2018E PE	Comment
Seagate	SELL	10.3x	HDDs are being replaced by flash/SSDs

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EUROPEAN UTILITIES

Robotaxis-
impact on sector ... **Growth:**



Margins:



ROIC:



Valuation:



KEY PIVOTAL QUESTIONS

Q: What are the implications of the shift towards robotaxis?

We believe the broad adoption of electric robotaxis could impact the sector in two main fronts: 1) electricity consumption increase, which in Europe we estimate at c20% through to 2050, assuming that over 45m of robotaxis would circulate in the region (note that the impact would be particularly high as these vehicles would have high utilization rates); and 2) increase in power infrastructure investment needs, as demand for new super-fast EV charging stations would increase, and thus the need to invest in new grid connections and reinforcement works. We estimate that around 50k super-fast charging stations across Europe could be required to cope with demand from c45m robotaxis. (Note, we assume 1 station with multiple charging points per 1,000 vehicles – 3 times larger than today's ratio on fuel stations, as charging times and mileage per vehicle are also higher).

Q: Does the shift in the OEMs' business model represent an opportunity or a threat?

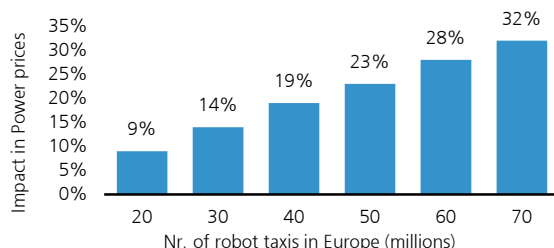
Overall we believe that such shift would come as an opportunity to the sector as it would i) support power demand growth – perhaps preventing continuing negative impact from consumption efficiency gains, ii) lead to power infrastructure growth, and iii) support new business opportunities around EV charging facilities & services.

FINANCIAL IMPACT

Q: What will be the financial impact on the industry?

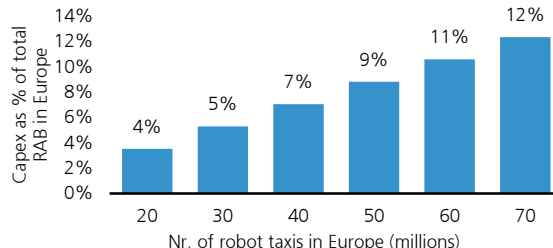
All else being equal, power demand would increase by over 20% through to 2050 and potentially lead to power price increases of c40%. Assuming no changes to the current power generation mix, this would increase avg. earnings across the European integrated utilities by more c50%. On the other hand, infrastructure capex needs – mostly in mid-voltage distribution networks - would increase by over €10bn – or €0.5bn per year through to 2040-50 (€220k per new connection point, across 50k stations in Europe. Capex assumption based in actual project cost), which seems relatively low when compared with the RAB across the major listed European utilities of €130bn (almost 10%).

Figure – Power demand change, Europe



Note: Key assumptions: 80k km/year/robotaxi. Unitary consumption: 0.19kWh/km. Source: UBS

Figure – Network capex requirements as % of RAB



Note: Based on historical info, we assume that each new connection line would cost c€220k. Source: UBS

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption from robotaxis?

Not yet, particularly at the grid level.

SECTOR VALUATION

Q: Could the trend to robotaxis lead to a change in sector valuation multiples?

No, given the lack of visibility on the potential impacts, and how far down these could be.

STOCK IMPACT

Q: What stocks will be impacted most positively and negatively?

Mostly utilities with high sensitivity to power price / demand growth in Europe: Fortum, EDF, as well as Uniper.

MOST FAVORED

Stock	UBS rating	2018E PE	Comment
Fortum / EDF	Buy / Neutral	21x / 22x	Highly sensitive to power price/demand changes

LEAST FAVORED

Stock	UBS rating	2018E PE	Comment
UU / SVT	Sell / Sell	20x/19x	No exposure to power price/demand or power networks

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Chemicals

Robotaxis –
impact on sector ... **Growth:**



Margins:



ROIC:



Valuation:



PIVOTAL QUESTIONS

Q: What are the implications of a shift towards robotaxis?

Automotive is one of the main end markets for the chemical industry, and production volume trends and technology shifts matter to a large number of companies under our coverage. To the extent that robotaxis would accelerate the shift towards EVs, robotaxis may further accentuate the challenges in the long term for chemicals companies with exposure to the combustion engine power train, while providing opportunities for EV pioneers and battery materials. For specialty polymers, a greater focus on interior design may create additional business opportunities in the medium term, although this would be offset by lower long-term new car sales. We have discussed the implications of EVs on the chemical industry [here](#).

Q: Does the shift in the OEMs' business model represent an opportunity or a threat?

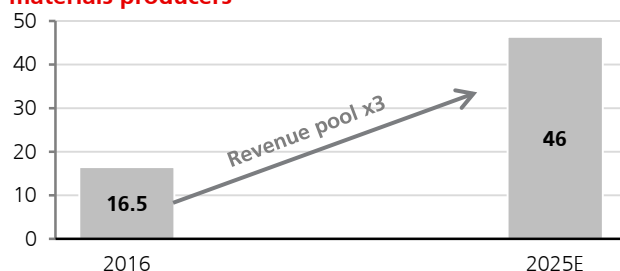
As robotaxis could support new car production in the medium term, this shift could prove a small positive overall for the next five years, but we would regard a drop in new car production longer term as a major threat for the broader chemicals space.

FINANCIAL IMPACT

Q: What will be the financial impact on the industry?

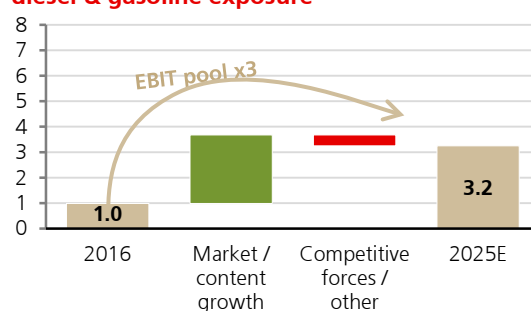
The impact will vary greatly depending on the specific chemicals exposed and types of applications within automotive. We see the greatest risk of a negative impact for auto catalysts (Johnson Matthey, BASF, Umicore), where a shift towards EVs and ultimately lower volumes would lead to substantial revenue losses. We see upside in terms of content growth for adhesives and polymers in interior design applications for Sika, EMS-Chemie and Lanxess. Umicore has the greatest leverage to potential battery materials growth related to EVs.

Revenue pool for EVs (€bn): beneficial for battery materials producers



Source: UBS estimates

EBIT pool (€bn): Opportunity at the cost of diesel & gasoline exposure



Source: UBS estimates

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption from robotaxis?

Not sufficiently. While EVs have become a theme for all chemical companies with auto exposure, the pace of penetration (one in three by 2025 in Europe) remains disputed, with Lanxess and EMS-Chemie, for example assuming a slower adoption (which is contrary to the view that robotaxis could speed up the shift).

SECTOR VALUATION

Q: Could the trend towards robotaxis lead to a change in sector valuation multiples?

While the valuation impact could prove material for a few names such as Johnson Matthey (diesel exposure in autocatalysts) or EMS-Chemie (>60% automotive exposure), we think the sector as a whole is too diversified across products and verticals to witness a significant change in valuation. Supply dynamics (regulatory crackdown in China), energy and feedstock costs curves and construction and consumer end-markets are likely to be more topical in the debates than robotaxis for the foreseeable future.

STOCK IMPACT

Q: What stocks will be impacted most positively and negatively?

To the extent that robotaxis would accelerate the migration to EV powertrains, this shift could impact a number of key stocks in our sector, both positively (Sika, Umicore) and negatively (BASF, EMS-Chemie, Johnson Matthey). Other companies impacted could include Lanxess (polymers and through a JV rubber for tires) and Covestro (polycarbonates).

**MOST
FAVORED**

Stock	UBS rating	2018E PE	Comment
Umicore	Buy	25.2x	Net beneficiary from leading position in cathode materials, outweighing diesel exposure in catalysts and risk to PGM pricing in recycling operations
LG Chemicals	Buy	12.6x	LG Chemicals has between 10% and 14% of global battery capacity; we expect the business to break even by 2018 and to grow by almost 3x 2017-21E
Asahi Kasei	Neutral	14.2x	We assume an EBIT increase of ¥15-30bn for LIB separators by 2025 (2017 base)
Sumitomo Chem	Buy	10.2x	We assume an EBIT increase of ¥8-25bn for LIB separators by 2025 (2017 base)
Sika	Buy	25.7x	c8% of group exposed to high-growth adhesives and sealants in EV market
Albemarle	Neutral	25.2x	We estimate c30% of 2018E EBITDA is battery-grade lithium, and we model that share growing to c.60% by 2025, with batteries for EVs being the largest market by then

**LEAST
FAVORED**

Stock	UBS rating	2018E PE	Comment
Johnson Matthey	Sell	16.7x	The biggest net negative impact due to size of light-duty diesel (16% of EBIT) and currently modest position in battery materials
EMS-Chemie	Sell	32.7x	Over 60% of sales exposed to transport end-markets, largely specialty polymers

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Capital Goods

Robotaxis-
impact on sector ...

Growth:



Margins:



ROIC:



Valuation:



KEY PIVOTAL QUESTIONS

Q: What are the implications of the shift towards robotaxis?

With a reduced number of cars on the road we see an adverse impact on overall auto capex and automotive consumables spend which forms about 10% of sector revenues. The reinforced trend towards EVs amplified our earlier comments on EV from the tear down of the Chevy Bolt. For instance, in terms of consumables, an EV could have up to 75% fewer moving parts and about 50-75% fewer bearings versus a traditional ICE vehicle. On the other hand, a shift to EVs would also imply incremental capex from factory upgrades given the higher number of platforms and the grid upgrade implications from the proliferation of an EV charging infrastructure.

Q: Does the shift in the OEMs' business model represent an opportunity or a threat?

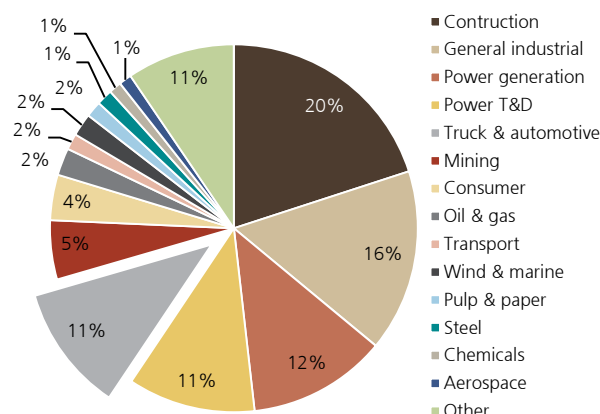
Both an opportunity and a threat. The shift to EVs (4.6x 2025 volumes) would be an opportunity for automation companies such as ABB and Siemens over the next years as they build out additional platforms. However, the 10% lower new car sales in the medium term could dampen auto capex growth as well as consumables revenues, and thereby revenue growth for the capital goods companies, especially for the direct component suppliers such as SKF and Rheinmetall.

FINANCIAL IMPACT

Q: What will be the financial impact on the industry?

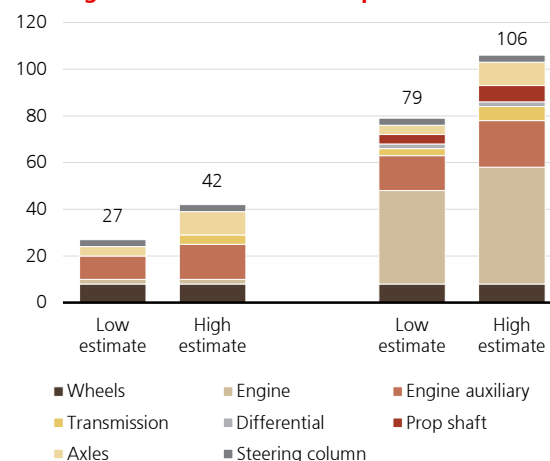
Given the breadth of our coverage, the impact would vary from company to company. With fewer cars, and furthermore those requiring up to 75% lower bearings, we see a potential for over 10% impact on SKF's auto division earnings.

Auto sector forms c.10% of sector revenues



Source: UBS, Company data

Bearings in a BEV vs an ICE car powertrain



Source: UBS estimates and analysis

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption from robotaxis?

We see automation players prepared to serve incremental demand from any platform switches or incremental capex in the space (the product is there). Assuming that robotaxis will largely be electric and autonomous, this will support the penetration of EVs, which, in turn, has implications for the sector. For instance, German car OEMs are planning to upgrade existing lines and we estimate BMW and VW will spend an incremental €10bn and €9bn, respectively, over the next c. five years on their BEV platform rollouts. It has not been disclosed how much of this will go towards tooling, but we expect upgrades to existing lines. We believe the industry is ready for this transition and will give companies such as Siemens, ABB, Hexagon and Kuka the opportunity for holistic discussions around production set-up. We see Siemens as particularly well positioned given its front-to-back offering from design software to motion control and factory automation. Component suppliers (Rheinmetall, SKF, etc) will need to adapt their products, but we believe this is a core topic for management teams at the moment.

SECTOR VALUATION

Q: Could the trend to robotaxis lead to a change in sector valuation multiples?

Not materially. While the valuation impact could prove meaningful for a few names such as SKF, we think the sector as a whole is too diversified across end-markets to witness a significant change in valuation.

**STOCK
IMPACT****Q: What stocks will be impacted most positively and negatively?**

As far as robotaxis would accelerate the migration to EV powertrains this shift could impact a number of key stocks in our sector, both positively (Siemens, ABB) as well as negatively (SKF, Rheinmetall, Sandvik).

**MOST
FAVORED**

Stock	UBS rating	2018E PE	Comment
Siemens	Buy	14.6x	Incremental auto capex good for Digital Factory (PLM, factory automation, motion control, estimate ca. 30% of sales driven by autos). Charging infrastructure positive for Energy Management ePowertrain pick-up positive for 50/50 JV with Valeo

**LEAST
FAVORED**

Stock	UBS rating	2018E PE	Comment
SKF	Sell	15.1x	c.20% of SKF's automotive sales relates to drive-train components for cars and light trucks (largely cars). With lower volumes and those too EVs, about 5-10% of SKF's top line today would disappear.
Sandvik	Sell	19.3x	Decreased steel and parts content combined with the transition to the electric motor from the combustion engine should impact Sandvik Machining Solutions.

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Global P&C Insurance (with motor insurance exposure)

Robotaxis –
impact on sector ...

Growth:



Margins:



ROIC:



Valuation:



PIVOTAL QUESTIONS

Q: What are the implications of a shift towards robotaxis?

Many insurance companies have large exposure to motor insurance, with some insurers like Admiral, Allstate and esure relying almost exclusively on this business. Motor insurers are acutely aware of the risk to their business models and have active strategies to (a) diversify their business models into other areas such as home insurance, and (b) work more closely with OEMs to try and take a larger share of a shrinking market in the future.

Q: Does the shift in the OEMs' business model represent an opportunity or a threat?

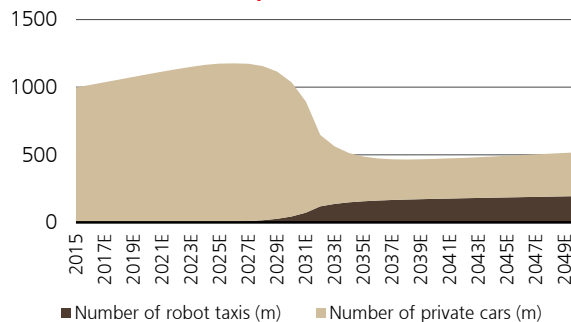
A reduction in new car sales, smaller car fleets, and a lower level of accidents is negative for the motor insurance industry. Those able to adapt most quickly and strike deals with OEMs are most likely to succeed.

FINANCIAL IMPACT

Q: What will be the financial impact on the industry?

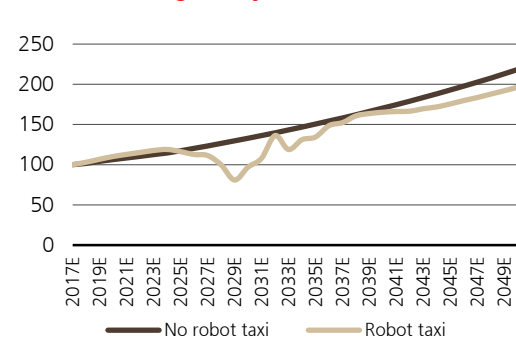
Our base case in this report assumes a 10% reduction in annual new car sales and a 48% reduction in the urban fleet vs today. This, combined with likely lower frequency of accidents, would lead to a very large reduction in motor insurance premiums. Insurers will most likely also need to shift from insuring individuals to insuring OEMs and robotaxi fleet operators; as such, we see scale within a specific country as a key competitive advantage.

Fleet mix: Robotaxi vs private cars (m)



Source: UBS estimates

New car sales globally (rebased to 100)



Source: UBS estimates

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption from robotaxis?

YES. Insurers are well aware of the risk from autonomous driving vehicles and pursuing strategies accordingly. Most P&C insurers are well diversified and such a shift would be gradual and have a limited impact.

SECTOR VALUATION

Q: Could the trend towards robotaxis lead to a change in sub-sector valuation multiples?

YES. Given the magnitude of the change in our forecast in our base case in this report. Such a scenario would lead to a major de-rating of the sub-sector and likely lead to some companies in the sector going under.

STOCK IMPACT

Q: What stocks will be impacted most positively and negatively?

We see stocks with the highest percentage to motor insurance as most impacted – especially those that do not have much diversification today

MOST FAVORED

Stock	UBS rating	2018E PE	Comment
Allianz	BUY	10.5x	Globally diversified with strong mix of business
Chubb	BUY	12.8x	Benefits from shift from personal to commercial insurance
James River Group	NEUTRAL	15.4x	Specialty insurer already insuring ride-sharing companies

LEAST FAVORED

Stock	UBS rating	2018E PE	Comment
Admiral	NEUTRAL	15.8x	Most of its earnings are motor insurance related
Allstate	NEUTRAL	13.4x	Most of its earnings are motor insurance related
esure	SELL	14.6x	Most of its earnings are motor insurance related

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Oil & Gas

Robotaxis-
impact on sector ... **Growth:**



Margins:



ROIC:



Valuation:



KEY PIVOTAL QUESTIONS

Q: What are the implications of a shift towards robotaxis?

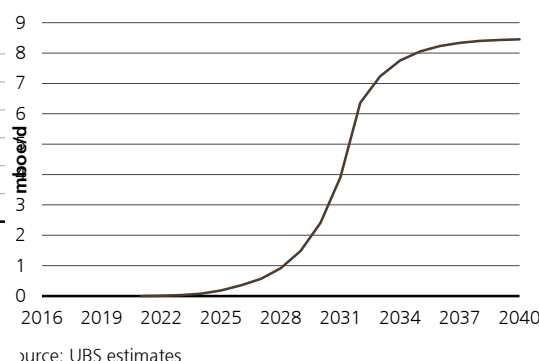
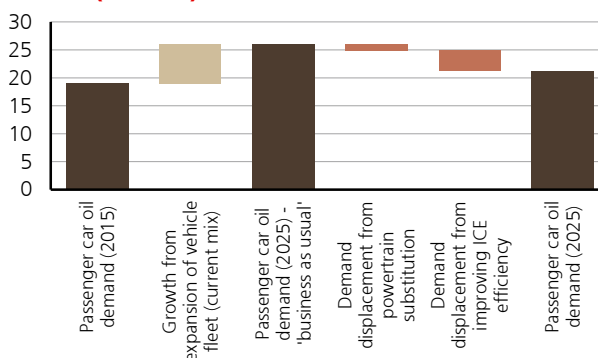
Automotive represents the single most important end market for oil: demand from passenger cars represents ~25% of total demand. Robotaxis are expected to be powered by electric engines, and would replace fossil-fueled cars. They would be a key driver of the shift towards the electrification of the car fleet, which we have incorporated into our oil demand forecasts (we tentatively project demand for oil plateauing at ~110Mb/d in the mid- to late 2030s). Based on the assumption that kilometers driven globally are split 40/60 between urban and non-urban, we calculate that the shift towards robotaxis as envisaged in this note would by itself have a negative impact of ~2.4Mb/d on global oil demand by 2030 and ~8.5Mb/d by 2040, or ~2.5% and 9% of current global oil demand, respectively. We would stress that these figures are highly speculative and that the market is likely to evolve quite slowly.

FINANCIAL IMPACT

Q: What will be the financial impact on the industry?

We highlighted in our recent note [Global Oil Fundamentals: Adjusting to a slower normalisation; scenarios for a future price path](#) an "all-electric" scenario in which it is difficult to envisage an equilibrium price for oil rising sustainably above \$60/bbl. A combination of existing production capacity and the most competitive conventional and unconventional development meet plateauing and subsequently falling demand.

Impact of growth in passenger vehicle fleet, power- train substitution and improving ICE efficiency on oil demand (2015-25)



Source: UBS estimates, BP Energy Outlook, IEA.

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption from robotaxis?

There is a clear debate currently around the timing of "peak oil" demand, driven by the car fleet's electrification, to which robotaxis would contribute. The general expectation in the industry is that the shift would take place in a more gradual fashion than that envisioned in this report. Some companies are preparing for it through investments in renewable energy, but these are still generally very limited.

SECTOR VALUATION

Q: Could the trend towards robotaxis lead to a change in sector valuation multiples?

Given the very long-term and speculative nature of these developments, we do not expect robotaxis to lead to a change in sector valuation multiples. The development of robotaxis and EVs in general is more of a threat to future projects than to existing assets. We note that the vast majority of oil companies currently trade at a discount to their 2P reserves valuation.

STOCK IMPACT

Q: What stocks will be impacted most positively and negatively?

Robotaxis, by accelerating the electrification of the car fleet, have the potential to be disruptive in the long term, but for the foreseeable future we see little to action in terms of stocks, given the low likely penetration in the medium term.

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Global Steel

Robotaxis –
impact on sector ...

Growth:



Margins:



ROIC:



Valuation:



PIVOTAL QUESTIONS

Q: What are the implications of a shift towards robotaxis?

The automotive sector currently accounts for c15% of global steel demand. Lower car volumes due to robot cars would change future demand dynamics. A 10% drop in annual new car sales would reduce global steel demand by c1.5%, or 2.5m t/y. Urbanization could offset volumes, but steel margins are usually higher in the car sector.

Q: Does the shift in the OEMs' business model represent an opportunity or a threat?

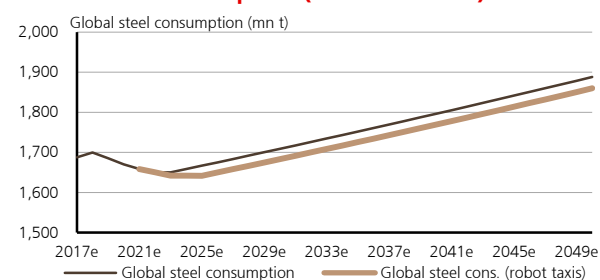
It is a threat to margins, but the volume impact might be limited. Losers would be mainly the higher-quality flat-steel producers, such as voestalpine, ThyssenKrupp, POSCO, and Hyundai Steel. Positives: Innovation becomes even more crucial for the industry. Negatives: Potential reduction in global crude steel volumes and lower margins for the entire industry.

FINANCIAL IMPACT

Q: What will be the financial impact on the industry?

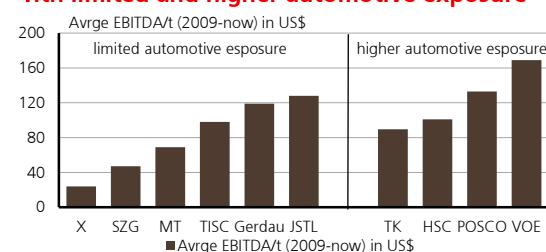
Reduced car volumes are unlikely to do the global steel sector any good. In the long run, steel capacities have to be cut even more, which might put the global steel companies under financial pressure, especially those with high exposure to the car industry, which enjoy higher margins than the rest of the steel industry.

Global steel consumption (rebased to 100)



Source: UBS estimates

Average historical EBITDA/t of steel companies with limited and higher automotive exposure



Source: UBS

SECTOR HEALTH CHECK

Q: Is the industry prepared for disruption from robotaxis?

NO. The global steel sector is still anticipating higher demand from the car sector. While the steel sector is concentrating on reducing steel capacity exposed to construction, a reduction in car volumes could be a challenge: Quality and innovation will be key. Those steel players with bigger R&D budgets might be the long-term winners.

SECTOR VALUATION

Q: Could the trend towards robotaxis lead to a change in sector valuation multiples?

No. Current valuations are still 10-40% below historical EBITDA/t calculations. Higher volatility in earnings due to less car industry exposed volumes is unlikely to contribute positively to a steel sector re-rating.

STOCK IMPACT

Q: What stocks will be impacted most positively and negatively?

MOST FAVORED

Stock	UBS rating	2018E PE	Comment
ArcelorMittal	Neutral	12.4x	Higher flexibility to shift volumes away from automotive

LEAST FAVORED

Stock	UBS rating	2018E PE	Comment
voestalpine	Sell	15.8x	60% of its flat-steel volumes are exposed to the car industry

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Appendix

Figure 96: Key conclusions from our three UBS Evidence Lab consumer surveys – Attitudes towards ride-on-demand and car ownership

	What was Evidence Lab survey Y'14 showing?	What is Evidence Lab survey Y'15 showing?	What is our latest Evidence Lab survey showing?	Change Y'16 vs Y'15
Consumer survey				
1				
Attitude towards "ride-on-demand"	40% of respondents "would take more taxis, or ride-on-demand services, if they were cheaper" 19% of respondents have used "Taxi or other chauffeur-driven services" at least once per month in the last year (45% at least once a year). This compares with 49% and 71%, respectively, for public transport 13% of the respondents using "ride-on-demand" have increased their usage of this transport mode over the past 12 months - Modes of transportation used less often due to using more "ride-on-demand" are 1) public transport, 2) city taxi, 3) bicycle, and 4) private cars (in that order) - Leaders in the field have a low level of awareness overall: 27% of respondents are familiar with Uber; 5% are using Uber "frequently" or "occasionally" (9% in the US, 1% in Japan) 3% of those over 44 increase their usage of "ride-on-demand"	50% of respondents "would take more taxis, or ride-on-demand services, if they were cheaper" with highest weight in China (65%) and lowest in US (36%) 18% of respondents have used "Taxi or other chauffeur driven services" at least once per month in the last year (43% at least once a year) 30%+ of the respondents using "ride-on-demand" increased their usage of this transport mode over the past 12 months (US from 26% to 37%, UK from 13% to 15%, France 16% to 28%) - Modes of transport used less often due to using more "ride-on-demand" are 1) public transport, 2) private cars, 3) city taxi and 4) bicycle (order has changed) 40% of respondent are now aware of the brand "Uber"; lowest level of awareness in UK (46% not aware) and Japan (91%) 17% of the 44+ years old increase their usage of "ride-on-demand"	68% of respondents would increase their usage of "ride-on-demand" if fares were dropped by 10%. 13% of respondents have used "ride-on-demand" services at least once per month over the last year. 13% used those services at least once per year. 33% of respondents using "ride-on-demand" increased their usage over the past 6 months. - Modes of transport used less often due to using more "ride-on-demand" are 1) public transport (36%); 2) private car (34%); 3) bicycle/ walking and 4) traditional car rental 83% of respondents are now aware of the brand "Uber"; lowest level of awareness in China (76% are aware or have used it) and the UK (79%) 21% of the 44+ year-olds increased their usage of "ride-on-demand"	Increased Decreased Increased Changed Increased Increased
2				
Attitude towards car ownership	- Majority of respondents own a car because it is convenient (65% of respondents "agree completely" or "agree somewhat" that owning a car is very important to them) - About 55% of respondents "agree completely" or "agree somewhat" with the statement "I prefer to drive myself, rather than have someone else drive me" - About 20% of respondents reduced the number of cars of the household after joining a car-sharing scheme, of which 80%+ sold one vehicle 40%+ of the respondents who plan to join a car-sharing/scheme plan to reduce the number of cars in the household Intention level to join a car-sharing/car-pooling scheme within the next 12 months is low (<1% "likely" and <5% "somewhat likely") but broadly in line with UBS expectations for car-sharing penetration levels - Key reasons to join a scheme: ... "ability to test innovation" and "problems parking locally" #1 reason NOT to join: "I like owning a car" (17%), "I don't think there is a car-sharing scheme" (15%), "trips can be made using other modes" (14%)	- Majority of respondents own a car because it is convenient (50%+ of respondents "agree completely" or "agree somewhat" that owning a car is very important to them) - About 55% of respondents "agree completely" or "agree somewhat" with the statement "I prefer to drive myself, rather than have someone else drive me" - About 23% of respondents reduced the number of cars of the household after joining a car-sharing scheme 50%+ of the respondents who plan to join a car-sharing/scheme plan to reduce the number of cars in the household Intention level to join a car-sharing/car-pooling scheme within the next 12 months has improved (c3% "likely" and c11% "somewhat likely") - Key reasons NOT to join: "I like owning a car", "I don't think there is a car-sharing scheme", "More hassle than owning a car"	34% of respondents name flexibility / convenience as the main benefit of car-ownership that "ride-on-demand" cannot meet - Of the respondents who are unlikely to use "ride-on-demand", 48% agree with the statement "I prefer to drive myself" - About 12% of respondents are very likely to reduce usage of their own car if they found that "ride-on-demand" was cheaper than owning a car 69% of respondents using "ride-on-demand" agree with the statement "ride-on-demand" will never fully replace car-ownership" - Key reasons NOT to use "ride-on-demand": "I prefer to drive myself", "less convenient to using a private car", "price of the ride"	Broadly unchanged Unchanged Unchanged

Source: UBS Evidence Lab

Figure 97: Key conclusions from our three UBS Evidence Lab consumer surveys – brand perception

3	Brand reputation is not a key criterion for a car purchase (except in the US) (not in the Top 5 of "very" or "somewhat" important) "Domestic brands" are most likely to be purchased (40%) against premium (7%) and no preference (25%) Social status is the least important criteria in deciding to buy a car (even including China)	Brand reputation is most important ("extremely" and "very" important) in China and US (69%) and least important in France and Japan (38%) 40% of respondents consider country of manufacturing "extremely" or "very" important 30% of respondents agree completely or somewhat that owning a car is a status symbol	Brand reputation is most important ("extremely" and "very" important) in China (73%) and the US (72%) and least important in the UK (59%) and France (62%) 39% of respondents consider country of manufacturing "extremely" or "very" important 5% of respondents agree that owning a car as a status symbol cannot be met by "ride-on-demand"	Increased Broadly unchanged
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Source: UBS Evidence Lab

Figure 98: Robotaxis models – Key underlying assumptions

Key variables	UBS base case		Caveats	Source
	Today	2030		
Purchase price	29,475	34,769	- Not a single winning technology today - Redundancy of sensors required - Complexity in reserved areas might be lower than fully automated	CPV for L5 at €5,000 (Valeo)
Number of trips per day	30	40	- Strong growth in demand - Robotaxis cheaper than public transports - System/platform optimisation <i>The outcome could be highly dependent on average vs peak demand, city density, EM vs DM</i>	NY, Singapore and SF transport authorities NYC taxi fleet could be reduced by 40% (MIT)
Number of kilometres per trip	4	8	- We blend of short-distance trips of 4km and long-distance trips of 18km (similar to the average daily commute distance in the UK today) <i>The outcome could be highly dependent on average vs peak demand, city density, EM vs DM</i>	NY transport authorities UK Census
Average idle time	10	5	- Powerful algorithms connecting demand with supply - Robotaxis operating as dynamic bus lines <i>The outcome could be highly dependent on average vs peak demand, city density, EM vs DM</i>	All trips can be shared waiting time increase by 5 minutes (MIT)
Average speed	31	31	We assume stable <i>The outcome could be highly dependent on average vs peak demand, city density, EM vs DM</i>	MIT
Residual value	50%	20%	- Sharp deterioration due to higher number of km driven - Further downside risk if car (incl. the battery) degrade further or have to scrapped <i>The outcome could be highly dependent on average vs peak demand, city density, EM vs DM</i>	Edmunds
Other financing items:				
Downpayment (%)	10%	10%	- Same assumptions as in our Chevy Bolt teardown Q-Series	
Government incentives (€)	0%	0%	- Same assumptions as in our Chevy Bolt teardown Q-Series	
Interest rate (%)	3.5%	3.5%	- Same assumptions as in our Chevy Bolt teardown Q-Series	
Time of ownership (years)	3	3	- Same assumptions as in our Chevy Bolt teardown Q-Series	
Running costs:				
Fuel consumption (l/100km)	8	na	- We assume all robotaxis will be electric	Spritmonitor
Electricity cost (€/kWh)	na	0.3	- Using current average for Germany today	
Tires (€ cents/km)	1.33	1.62	- Higher cost due to higher curb weight in an EV	Automobile Association, UBS
Service labour costs (€ cents/km)	1.43	0.57	- Maintenance costs 60% lower in an EV	Automobile Association, UBS
Replacement parts (€ cents/km)	1.54	0.62	- Maintenance costs 60% lower in an EV	Automobile Association, UBS
Parking and tolls (€ cents/km)	1.37	0.64	- Related to the higher utilisation rate	Automobile Association, UBS
Insurance (€/year)	529	529		
Annual inspection (€/year)	175	175		
Base fare (€):				
City	London	London	- Our interactive allows to choose between 17 cities	UberX, UBS
Base (per trip)	2.8	1.6	- Our interactive allows to choose between 17 cities	UberX, UBS
Duration fare (per min)	0.2	0.1	- Our interactive allows to choose between 17 cities	UberX, UBS
Distance fare (per km)	0.9	0.5	- Our interactive allows to choose between 17 cities	UberX, UBS
Min fare	5.5	3.3	- Our interactive allows to choose between 17 cities	UberX, UBS
Urbanisation (as % of world population)	55%	66%	- Not all cities will adopt robotaxis <i>The outcome could be highly dependent on average vs peak demand, city density, EM vs DM</i>	United nations
Car penetration (# car per 1,000 inhabitants)	250	193	- Car penetration can be as low as 30 (India) and as high as 800 in the US <i>The outcome could be highly dependent on average vs peak demand, city density, EM vs DM</i>	European car association (ACEA) IHS Global Insight
Peak vs low demand			- The gap peak vs off-peak demand will have material impacts on our forecasts and total number of annual vehicle sales may exceed current ones. MIT - Traffic could also become more fluid thanks to 1) behaviour change (vehicle becomes an extension of home/office), 2) connected traffic lights and 3) System/platform optimisation <i>The outcome could be highly dependent on average vs peak demand, city density, EM vs DM</i>	NY transport authorities

Source: UBS

Figure 99: Ride-on-demand – key players in each of the major markets (in addition to Uber)

Total Share, Rank	Country	Other notable players	Total Share, Rank	Country	Other notable players	Total Share, Rank	Country	Other notable players
1	ZA	Taxify	16	NL	BlaBlaCar	31	CN	Didi, Yongche, Shenzou Zhuanche
2	NZ		17	TW	Local taxi companies	32	PH	Grab
3	BR	Easy Taxi	18	AT	BlaBlaCar, mytaxi	33	IE	Hailo
4	CA		19	SE	Local taxi companies	34	ID	Grab, Go-Jek
5	AU		20	DK	Gomore	35	IT	BlaBlaCar, mytaxi
6	MX	Cabify, Easy Taxi	21	BE	BlaBlaCar	36	JP	Local taxi companies, LINE Taxi
7	CL	Cabify, Easy Taxi	22	IN	Ola, Jugnoo	37	TH	Grab
8	GB	Gett, Addison Lee	23	SG	Grab	38	GR	Taxibeat
9	NO		24	PL	BlaBlaCar, mytaxi	39	DE	BlaBlaCar, mytaxi
10	FI	Taxify	25	FR	BlaBlaCar, Heetch	40	TR	BlaBlaCar, BiTaksi
11	CO	Easy Taxi, Cabify	26	MY	Grab	41	RU	Yandex Taxi, Gett, BlaBlaCar
12	CH	BlaBlaCar	27	CZ	BlaBlaCar, Liftago	42	ES	BlaBlaCar, mytaxi, Cabify
13	HU	Taxify, BlaBlaCar	28	SA	Careem, Easy Taxi	43	IL	Gett, Waze Rider
14	PT	mytaxi, Cabify, BlaBlaCar	29	VN	Grab	44	KR	Kakao Taxi
15	US	Lyft	30	HK	Local taxi companies			

Source: UBS Evidence Lab

Figure 100 summarises the feedback we received in discussions with eight experts including DriveNow, Frost & Sullivan, BMW i-Ventures and the International Transport Forum.

Figure 100: What are experts saying about shared mobility?

Expert	Feedback
DriveNow (BMW/Sixt JV)	- Car sharing members in Europe could reach ~15m by 2020 - Free-floating car sharing growth has significantly outperformed station-based sharing in Germany - DriveNow offers fully-flexible premium car sharing and has >600k customers in 9 cities - DriveNow's customers are BMW's youngest target group with an average age of 33 years, of which ~70% have no children
Frost & Sullivan	- OEMs' business model is shifting towards integrated mobility services - Opportunities for OEMs: (1) larger addressable market; (2) marketing/ testing tool; (3) increasing time spent in cars - Challenges: (1) car ownership remains at high levels in metropolitan regions; (2) brand commoditization; (3) risk of new entrants
EasyCar (P2P car sharing)	- Peer-to-peer car sharing can offer attractive returns for owners - Key reasons for rental are local holidays and visiting friends or relatives - 78% of vehicle rentals occur during weekends - Key challenges are: for owners, existing insurance/lease agreements; for renters, roadworthiness and confidence in fulfilment
NYU	- Sharing mobility is being driven by (1) urbanization, (2) smartphone penetration and (3) high cost of traffic congestion - As a result, the share of young people (<40 years) with a driving licence has continued to decline - Positive public perception of ride-hailing - Potential to reduce drunk-driving (Uber offered free rides in Canada for customers exceeding legal blood alcohol limit)
BMW i-Ventures (BMW's VC arm)	- Investment in Moovit: mobile application that enables tracking of public transport with more than 35m customers, available in >1,000 cities globally - Investment in Zendrive: smartphone application that uses the sensors to improve driving behaviour and analyses ~4.8bn km per month
ITF (International Transport Forum)	- ITF simulated the impact from replacing all car/ bus trips in a city with shared on-demand vehicles - Key conclusions are: (1) only 3% of today's fleet would be needed; (2) congestion would disappear; (3) the total number of parking spaces required would be 95% lower; (4) each shared vehicle would cover 260km/day; (5) CO2 emissions would be reduced by a third
Lyft (former Director of Operations Strategy)	- Future of shared mobility could be analogous to today's airline industry: small group of OEMs supplying vehicles to consumer-facing networks - Autonomous vehicles are likely to be fully electric, but charging time could constitute a risk to the utilization rate of fleet - All players in the sharing economy will need access to vehicle data - Players like Google likely to focus on operating system for autonomous vehicles
Gett (Head of Business Development)	- Gett currently has a 45% utilization rate of the vehicle fleet during working hours of the driver vs 20% for an 'old-school' cab - Key to profitability is bringing down the time span between the booking and arrival of the car below 3mins from 3.5mins currently - Russia's Sberbank replaced its corporate car fleet with Gett, which translated into 50% cost savings

Source: UBS

Figure 101: OEM exposure to ride-on-demand

OEM	Drive yourself business model				Be driven business Models				Integrated Mobility	Smart Parking		E-mobility	
	One way CS	Two way CS	P2P CS	Corp. CS/flex leasing	Ride sharing	Taxi Hail	Ride Hail	Chauffeur service		Parking Mgmt.	P2P Parking	EV Charging	Renewable energy
Daimler	✓			✓		✓		✓	✓	✓✓	✓		
BMW	✓			✓	✓✓	✓			✓	✓✓		✓✓	✓
Audi				✓									
Volvo		✓											
VW	✓	✓✓		✓		✓							
Ford	✓	✓✓	✓	✓					✓✓	✓			
PSA	✓✓		✓	✓									
Renault-Nissan	✓✓			✓									
Toyota	✓✓	✓✓			✓		✓						
Honda	✓												
GM	✓	✓	✓				✓✓						
FCA	✓			✓									
Hyundai		✓											

Legend	
Subsidiary	✓
Through VC arm	✓
Strategic Partnership with Investment	✓
Collaboration (no investment)	✓

Source: Frost & Sullivan, UBS

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For this report, UBS Evidence Lab analysed daily rankings and download estimates for ride-on-demand apps using Sensor Tower data. UBS Evidence Lab tracks daily rankings for thousands of mobile applications in the iOS and Google Play store across more than 40 countries. App data presented in this report are through the end of June 2017.

The survey was sent out via an online methodology to a representative panel of consumers (based on gender, age and income distribution) across China (Tiers 1 and 2), US, France, the UK and South Africa in September, 2016. In total 15,607 respondents took part in the survey, of which 3531 are based in China, 2833 are based in the US, 3161 are based in France, 3319 are based in UK and 2763 are based in South Africa. The margin of error for whole sample responses is between +/-0.78 (total sample) and approximately +/-1.79 (individual countries).

For this report, the UBS Evidence Lab Price Intelligence team collected Uber prices on a weekly basis for ~600 markets across ~70 countries since April 2016. The price data is current as of August 2017. For each market, we collect the vehicle type and variables related to pricing such as the base fare, the cost per minute, and the cost per unit of distance. We then use these variables to estimate the cost of a representative route. All of the prices presented in this report are for UberX and they assume no surge pricing. Through this capability we are able to identify new market launches for Uber and also track the changes in Uber pricing in local currency. We also converted the prices to euros as well as PPP-adjusted the prices to compare the cost per ride across markets.

Valuation Method and Risk Statement

The automobile sector has in the past shown high levels of volatility in terms of profitability and valuation. Sector earnings and performance are highly sensitive to variations in volume, pricing, raw material costs and currency, all of which have been volatile recently. Long-term structural trends continue to improve as a result of higher demand in EM, early signs of sector concentration improving and structurally lower currency exposure, but near-term cyclical drivers have become more challenging after several years of strong earnings and share price performance. We are also concerned that in a macro recovery rising interest rates would become a material headwind for the industry.

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Buy	FSR is > 6% above the MRA.	45%	28%
Neutral	FSR is between -6% and 6% of the MRA.	38%	27%
Sell	FSR is > 6% below the MRA.	17%	11%
Short-Term Rating	Definition	Coverage ³	IB Services ⁴
Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%
Sell	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%

Source: UBS. Rating allocations are as of 30 June 2017.

1: Percentage of companies under coverage globally within the 12-month rating category.

2: Percentage of companies within the 12-month rating category for which investment banking (IB) services were provided within the past 12 months.

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Company Name	Reuters	12-month rating	Short-term rating	Price	Price date
ABB Ltd ^{5, 6b, 6c, 7, 13, 16}	ABBN.S	Sell	N/A	CHF23.87	28 Sep 2017
Admiral Group ^{5, 13, 14}	ADML.L	Neutral	N/A	1,803p	28 Sep 2017
Aisin Seiki	7259.T	Buy	N/A	¥6,010	28 Sep 2017
Albemarle Corp ¹⁶	ALB.N	Neutral	N/A	US\$130.02	27 Sep 2017
Allianz S.E ^{4, 5, 6a, 7}	ALVG.DE	Buy	N/A	€186.85	28 Sep 2017
Allstate Corp. ^{5, 6b, 7, 13, 16}	ALL.N	Neutral	N/A	US\$90.89	27 Sep 2017
ArcelorMittal ¹⁶	MT.AS	Neutral	N/A	€21.51	28 Sep 2017
Asahi Kasei	3407.T	Neutral	N/A	¥1,376.0	28 Sep 2017
Autoliv ¹⁶	ALV.N	Sell	N/A	US\$123.28	28 Sep 2017
BASF SE ^{2, 4, 5, 7, 14}	BASFn.DE	Buy	N/A	€89.12	28 Sep 2017
BMW ⁷	BMWG.DE	Neutral	N/A	€84.42	28 Sep 2017
Chubb Limited ^{5, 7, 16}	CB.N	Buy	N/A	US\$141.91	27 Sep 2017
Clariant ^{3, 4, 5, 6b, 6c, 7, 13, 18, 59}	CLN.S	Restricted	N/A	CHF23.07	28 Sep 2017
Continental	CONG.DE	Buy	N/A	€214.00	28 Sep 2017
Covestro AG ²	1COV.DE	Buy	N/A	€72.48	28 Sep 2017
Daimler	DAIGn.DE	Buy	N/A	€66.65	28 Sep 2017
Delphi Automotive Plc ¹⁶	DLPH.N	Buy	N/A	US\$98.78	27 Sep 2017
Denso ⁷	6902.T	Neutral	N/A	¥5,747	28 Sep 2017
EDF ⁷	EDF.PA	Neutral	N/A	€10.62	28 Sep 2017
Ems-Chemie ⁵	EMSN.S	Sell	N/A	CHF645.50	28 Sep 2017
Esure Group	ESUR.L	Sell	N/A	282p	28 Sep 2017
FCA ^{5, 7, 16}	FCHA.MI	Neutral	N/A	€14.85	28 Sep 2017
Flex ¹⁶	FLEX.O	Buy	N/A	US\$16.70	27 Sep 2017
Ford Motor Co. ^{16, 26a}	F.N	Buy	N/A	US\$11.95	27 Sep 2017
Fortum	FORTUM.HE	Buy	N/A	€16.82	28 Sep 2017
General Motors Company ^{7, 16}	GM.N	Buy	N/A	US\$40.58	27 Sep 2017
Gestamp Automoción S.A. ^{2, 4, 5}	GEST.MC	Buy	N/A	€5.37	28 Sep 2017
GKN ^{5, 14}	GKN.L	Buy	N/A	343p	28 Sep 2017
Hella	HLE.DE	Buy	N/A	€50.38	28 Sep 2017
Honda Motor ¹⁶	7267.T	Neutral	N/A	¥3,362	28 Sep 2017
Hyundai Steel	004020.KS	Neutral	N/A	Won52,300	28 Sep 2017
Infineon Technologies AG ⁷	IFXGn.DE	Buy	N/A	€21.02	28 Sep 2017
Jabil Circuit, Inc. ¹⁶	JBL.N	Buy	N/A	US\$28.81	27 Sep 2017
Johnson Matthey ⁷	JMAT.L	Sell	N/A	3,420p	28 Sep 2017
JSW Steel	JSTL.BO	Sell	N/A	Rs238.90	28 Sep 2017
Lanxess AG ¹³	LXSG.DE	Neutral	N/A	€66.94	28 Sep 2017
Lear Corporation ^{6c, 7, 16}	LEA.N	Buy (UR)	N/A	US\$172.69	27 Sep 2017
LG Chemical	051910.KS	Buy	N/A	Won386,000	28 Sep 2017
Magna International ¹⁶	MGA.N	Neutral	N/A	US\$53.58	27 Sep 2017
Mazda Motor	7261.T	Buy	N/A	¥1,740.0	28 Sep 2017
Melexis NV	MLXS.BR	Sell	N/A	€80.89	28 Sep 2017

Company Name	Reuters	12-month rating	Short-term rating	Price	Price date
Michelin	MICP.PA	Buy	N/A	€122.50	28 Sep 2017
Nokian ⁵	NRE1V.HE	Neutral	N/A	€37.55	28 Sep 2017
POSCO ¹⁶	005490.KS	Buy	N/A	Won315,500	28 Sep 2017
PSA Group	PEUP.PA	Neutral	N/A	€19.86	28 Sep 2017
Renault ⁷	RENA.PA	Buy	N/A	€82.11	28 Sep 2017
Rheinmetall	RHMG.DE	Buy	N/A	€95.28	28 Sep 2017
Samsung SDI ^{7, 22}	006400.KS	Buy	N/A	Won200,000	28 Sep 2017
Sandvik	SAND.ST	Sell	N/A	SKr140.10	28 Sep 2017
Schaeffler	SHA_p.DE	Sell	N/A	€13.51	28 Sep 2017
Seagate Technology PLC ^{6b, 7, 16, 26b}	STX.O	Sell	N/A	US\$33.18	27 Sep 2017
Severn Trent	SVT.L	Sell	N/A	2,161p	28 Sep 2017
Siemens ^{2, 4, 5, 6a, 7, 22}	SIEGn.DE	Buy	N/A	€118.05	28 Sep 2017
Sika ^{5, 6b, 6c, 7, 13}	SIK.S	Buy	N/A	CHF7,210.00	28 Sep 2017
SK Innovation ⁷	096770.KS	Buy	N/A	Won194,500	28 Sep 2017
SKF B	SKFb.ST	Sell	N/A	SKr175.70	28 Sep 2017
STMicroelectronics ^{5, 7, 16}	STM.PA	Sell	N/A	€16.22	28 Sep 2017
Subaru	7270.T	Sell	N/A	¥4,083	28 Sep 2017
Sumitomo Chemical	4005.T	Buy	N/A	¥707	28 Sep 2017
Taiwan Semiconductor Manufacturing ¹⁶	2330.TW	Buy	N/A	NT\$214.00	28 Sep 2017
Tenneco Inc. ¹⁶	TEN.N	Buy	N/A	US\$60.58	27 Sep 2017
Tesla, Inc. ¹⁶	TSLA.O	Sell	N/A	US\$340.97	27 Sep 2017
Texas Instruments Inc. ¹⁶	TXN.O	Buy	N/A	US\$88.81	27 Sep 2017
ThyssenKrupp ¹³	TKAG.DE	Sell	N/A	€25.21	28 Sep 2017
Toyota Motor ^{7, 16}	7203.T	Sell	N/A	¥6,769	28 Sep 2017
Umicore	UMI.BR	Buy	N/A	€69.51	28 Sep 2017
United Utilities	UU.L	Sell	N/A	845p	28 Sep 2017
Valeo	VLOF.PA	Buy	N/A	€62.02	28 Sep 2017
Visteon Corp. ^{4, 5, 6a, 6b, 7, 16}	VC.N	Neutral	N/A	US\$124.00	27 Sep 2017
voestalpine AG	VOES.VI	Sell	N/A	€43.00	28 Sep 2017
Volkswagen ^{7, 13}	VOWG_p.DE	Buy	N/A	€138.35	28 Sep 2017

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