

The Effect of Autonomous Vehicles on Parking Assets

Special Report

Vehicles in the Future: Autonomous vehicles (AV) will affect demand for most transportation assets as technology evolves. Fitch Ratings is evaluating negative, neutral and positive outcomes for existing infrastructure assets.

Fitch's opinion is full autonomy will most likely negatively affect parking assets, since AVs reduce the need for car ownership, have reduced down time given alternate usage capabilities and if owned, will be parked more remotely at a lower cost. AVs used for ride sharing (RS) will be less costly without a driver and likely cheaper than owning a car, when factoring in insurance, fuel and value of time.

Unknown Time Horizon: Substantial investments from traditional car manufacturers, technology companies, and new market entrants have been made in enhanced initial AV functionality, such as speed and breaking control, driver assist to avoid lane drifting, and parking assist. However, there have been setbacks with a number of high profile accidents. The regulatory framework, insurance and other legal matters must also be addressed. The timing and pattern of AV adoption is uncertain but it appears inevitable in the next few decades.

Parking Assets Appear Vulnerable: We rate parking debt secured by revenue from municipal on street and city garage, airport, and stand-alone university parking. Fitch believes urban parking is the most at risk, since AVs could use a RS model or travel to cheaper parking locations in the outskirts. The exposure is less pronounced, though it may be meaningful for airport parking and consolidated rental car facilities (CONRAC) and sports facilities, where parking exposure is a share of revenue.

Effects on Ratings: Fitch did not take any rating actions or apply Negative Outlooks to parking issuers solely due to risk from AVs and RS. Widespread use of fully AVs, which would have the greatest effect on driving behavior, is not expected for more than a decade. Contractual obligations such as third-party, long-term leases and robust reserves are mitigants to increasing risk. We will also assess whether project managers are taking proactive measures to offset demand risk, with alternative uses such as charging stations, staging areas, etc.

A major consideration for existing transactions is leverage is managed so it is low before the potential effects of AVs ramp up 10 to 20 years from now. Structural changes, such as triggers for prepayments, can allay concerns about issuing long-term debt, when the extent and speed of revenue declines is uncertain. Increased long-term leverage without protections will be adverse for credit quality.

Greater Range of Sensitivities: Existing issuers experienced minimal effects from this technology so far but there is risk from rapid change. Fitch develops sensitivities based on potential timing, rate-making flexibility and other operational adjustments to evaluate the robustness and resiliency of the issuer credit profile, specifically related to this risk.

Scope of Report: This report aims to provide Fitch's insights and opinions related to credit implications of AVs, analysis related to parking specific assets and ratings, and our approach to existing and new parking assets and other topics.

Related Research

[Fitch: Charging Infrastructure is Needed for Wider EV Adoption \(April 2018\)](#)

[U.S. Autos: Key Industry Rating Issues \(November 2017\)](#)

[Driverless Cars to Transform Motor Insurance \(March 2017\)](#)

Analysts

Anne Tricerri
+1 646 582-4676
anne.tricerri@fitchratings.com

Chad Lewis
+1 212 908-0886
chad.lewis@fitchratings.com

Scott Zuchorski
+1 212 908-0659
scott.zuchorski@fitchratings.com

Credit Implications of AVs

Once AVs enter the market they will undoubtedly affect all modes of transportation infrastructure. Fitch believes the first major sector to experience a significant effect will be parking. The goal of this report is to address questions related to the emergence of AVs and what effect AVs will have on the financial strength of parking assets.

Potential Barriers to the Adoption of AVs

There is a multitude of barriers that could delay the adoption of AVs including acceptance, safety issues, infrastructure investment, applicable regulations and laws, and insurance-related hurdles.

Generational and Cultural Acceptance

Generational differences, such as norms and preferences, will likely play a role in who supports AVs, especially in the early years. Millennials and Generation Z are the most common users of RS applications and recent studies have shown they are less likely to obtain a driver's license. This is particularly true in urban areas and younger generations are increasingly moving to large cities. A University of Michigan study found from 1983 to 2014 there was a 47% drop in 16 year olds with a driver's license, ages 20 to 24 showed a 16% decline, and ages 30 to 34 showed a 10% decline.

A study by the University of California, Davis found more than 36% of individuals between the ages of 18 to 29 years old use ride-hailing services, while only 4% of individuals 65 and older do. These trends suggest Millennials and Generation Z will embrace AVs. There are also counter studies, which suggest younger generations are not necessarily more likely to embrace AVs. Even so, major urban areas, which are increasingly a draw for young generations, are expected to be at the forefront of AV adoption.

To provide some perspective, E-ZPass, or electronic tolling, was created in 1987 and has very high usage rates in the greater New York City, NY area. Usage is more than 90% on the Hudson River and East River Crossings and there is also high usage for similar electronic tolling methods in other major densely populated metropolitan areas. Usage rates in moderately sized areas are significantly lower at 70%–80% signaling even if the technology exists, a significant transition period is highly likely along with a cap to usage.

Generation Z Car Usage

With less of the younger generation learning to drive there will be greater usage of RS and public transportation. The younger generation will be more focused on travel options with less emissions. Using an AV can potentially be cheaper than owning, parking, maintaining and insuring a car. Another benefit of using a fully AV will be the opportunity to use travel time to multitask and use hand held communication devices, which can be used to order and instruct an AV.

Human Error

Drivers of conventional vehicles will need to be accustomed to AVs following all rules of the road, such as obeying the speed limit and maintaining the recommended distance between cars. This was experienced before with the gradual change from horse and carts to motorized vehicles.

Related Criteria

[Rating Criteria for Infrastructure and Project Finance \(July 2018\)](#)

[Toll Roads, Bridges and Tunnels Rating Criteria \(July 2018\)](#)

Technological Advances

Many vehicles are already incorporating aspects of AV technology, such as functionality preventing swerving out of a lane and automatic braking. These features allow users to become comfortable with giving technology some control over vehicles.

Safety Issues

Several high profile accidents involving AVs raise safety issues, which could delay the rollout of AVs to consumers. AVs have the potential to drastically reduce vehicular accidents but the public will have to endure inevitable teething problems as the technology is perfected. Major concerns include the ability of AVs to interact with regular vehicles and to make appropriate decisions to avoid accidents.

For example, AVs will need to recognize the difference between pedestrians and other objects in the AV's path. There are also technological concerns, such as software bugs; computer, Wi-Fi and control failures; and cybersecurity to prevent hacking. AVs will have to employ redundancy in case of any technological failures. Unanswered safety concerns raised skepticism among potential consumers of how successful the technology will be.

Ownership

It is likely individuals will own electric vehicles (EV), as they own their current car, but when AVs are available it is likely the benefits of ordering a certain type of AV when needed will outweigh the costs associated with owning a vehicle.

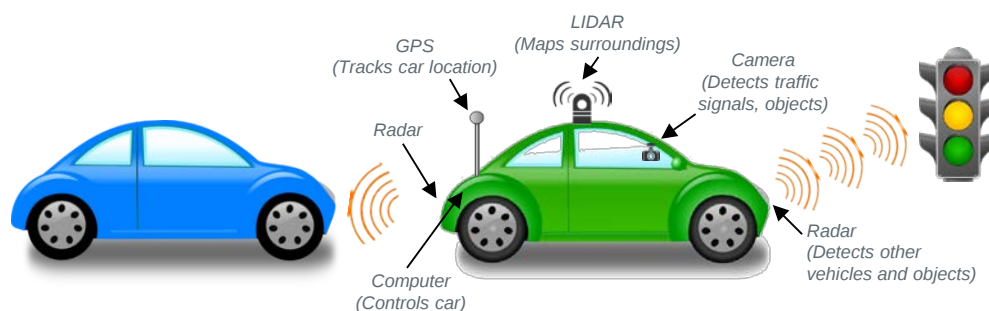
Infrastructure Investment

Investments in the infrastructure network would facilitate the use of AVs on roads and highways. Currently, physical and digital infrastructure is lacking and AVs are not properly supported. AVs rely on technology, such as LiDAR, radars and cameras to digitally map out the road ahead, assisting the vehicle along the way and planning a safe route. The digital infrastructure system, known as vehicle to infrastructure (V2I), helps AVs anticipate what is ahead of the vehicle to make proper decisions on how to navigate the roadways.

The V2I system needs to be upgraded so AVs can easily connect to it and share critical information with other vehicles in the fleet, including signal phasing, timing and live traffic conditions. This form of communication allows AVs to better navigate icy or wet roads and areas of high wind. Other physical infrastructure requirements include repainting lines on the roads and highways so they can be detected by AVs to ensure a safer ride. Additionally, since most AVs are being developed as EVs, while some are hybrids, central charging stations are required. For EVs placement of stations must be strategic so users will be confident they will not run out of battery power during trips. Users could order a replacement for an AV if needed.

AV developers are proceeding with the technology, since they cannot rely on or wait for local governments to upgrade infrastructure to enable V2I. However, there are examples of toll road enterprises making infrastructure improvements, which will facilitate AVs. Fiber-optic cable infrastructure facilitates communication between vehicles and with the surrounding infrastructure. Ohio Turnpike is building upon its fiber-optic cable infrastructure by adding wireless sensors. Ohio Turnpike also plans to install electric charging stations at selected service plazas in 2019. Pennsylvania Turnpike is pursuing a public-private partnership to install fiber-optic cable within its right-of-way to provide connectivity for all electronic tolling but it could also be used for AVs.

Autonomous Vehicle Technology



Source: Fitch Ratings.

Who Buys Insurance?

The development of AV technology will likely reshape the automotive industry insurance market. Under current insurance models the driver of the vehicle is the customer but with the introduction of AVs the question of who the customer is will likely change. There is not a clear model for what this will look like in the U.S. Proposed legislation in the U.K. addressing the question of liability could potentially serve as a model for the U.S. The legislation suggests the manufacturer will be at fault if an accident is caused due to a technological failure.

At first this may be hard to determine and the process of claiming funds after an accident may be delayed. There are also ethical issues that will make it difficult to assess accidents. For example, AV software will have to make difficult decisions, such as whether to swerve to avoid a pedestrian but risk hitting an obstacle and endangering passengers. As AVs develop and become more common, a key component of the new insurance model will be data sharing. Through data sharing insurers will have an easier time determining who was at fault for the accident and should be held liable.

Cyber Risk

Cyber risk exposure will need to be addressed by the insurance industry. AVs will rely on connected infrastructure and will be vulnerable to hacking attempts. Furthermore, there is a chance AVs will be prone to software bugs and other various control failures, especially in the early stages, which could result in potential accidents. Waymo is an example of one company thinking ahead about this issue. The company partnered with an insurance start-up company to provide insurance for all passengers in the AV test fleet.

Implications of Individual Ownership Versus Sharing of AVs

Ownership of AVs will dictate future demand for parking. The average car is parked approximately 95% of the day according to Donald Shoup, the author of *The High Cost of Free Parking*. Trends in individual car ownership are expected to change with individuals owning fewer or no cars. Fewer individually owned cars and fully AVs, which could be sent home until needed, would erode parking demand.

Parking demand could also decline if AVs are rolled out as a mobility as a service or as a fleet model. Having the flexibility to order an AV when required may be a cheaper option as it saves the user from capital outlay for a vehicle or lease payments, costs of maintenance/services and cost of insurance. In this scenario, individuals will hire AVs to complete trips and use RS as the primary method of transportation.

Since there is no cost for drivers with fully AVs, the cost of RS declines significantly, potentially making the cost of RS competitive with car ownership. AVs operating via RS will require less space for parking since they will spend more time on the road completing trips with little need to park other than to charge and be serviced.

Certain Types of Parking Assets Are More Vulnerable to AVs and RS Technology

Certain parking assets are likely more vulnerable to disruption from AVs. Fitch identified risks for three major types of parking assets: urban, airport and university. However, we note, it continues to be a case-by-case analysis.

Parking Assets' Exposure to Risk from AVs



Source: Fitch Ratings.

Urban Parking

Fitch believes urban parking assets are the most vulnerable to AVs. Some reports cited drivers looking for parking contribute up to 30% of the congestion in an urban area. If an individual uses an AV that can operate without a driver behind the wheel, parking demand is expected to decline. The AV can drop off the individual and travel to a cheaper parking space further away from the urban center. When the user is ready to be picked up, the user will summon the vehicle.

Full autonomy, when a vehicle can perform all functions without a driver, will first be deployed in geofenced areas, which are likely to be established in urban areas. If AVs are used via RS, a vehicle will only need to park to recharge or be serviced, which decreases the demand for parking in urban areas. Fitch recognizes not all individuals or job types are candidates for AVs and there will be continued demand for service and repair vehicles, for example, where it is necessary to have a vehicle with tools and parts readily accessible.

We also note geographical differences between cities will dictate the effects of urban parking. The top 10 MSAs in the U.S. have very different commuting patterns and have a host of factors that could contribute to very different levels of parking/market penetration rates. Some politicians are implementing congestion policies, which would reduce the number of vehicles in city centers and reduce parking demand.

There are also different options for municipalities managing parking assets compared to those granting a concession. Some parking facilities already adapted current facilities to offer other products such as premium parking or a car wash while you wait and charging facilities.

Municipalities may continue to adapt and allocate space for AVs to rest and charge, while being parked tighter than current cars can. Municipalities can more easily transform parking assets, such as adding charging stations or redeveloping the land, than if bound by a concession agreement.

Airport Parking

Ground transportation and parking is a significant source of revenue for airports. Some airports already experienced significant disruption to revenue streams and demand for parking from the transportation network companies (TNC). Some airport passengers are shifting away from using airport parking lots, rental car companies, taxi services and other modes of ground transportation. Our rated airports will be affected differently. This depends on an airport's reliance on car park revenue and on composition of passengers, other modes of transportation, and links to public transportation. This includes buses and rail and the location relative to the central business district or employment centers.

The Federal Aviation Administration reported in November 2017 fees from parking and ground transportation comprised 42% of airport revenue from sources excluding airline fees. To make up for the loss in revenue some airports charge a fee for TNCs including Uber Technologies, Inc. and Lyft, Inc. to pick up and drop off passengers at the airport. Other airports started parking clubs, providing guaranteed parking spaces within close proximity to the terminal for members, access to shorter security lines, and other perks as incentives for frequent flyers to join.

AVs will likely further reduce demand for parking at airports. AVs used as RS vehicles will drop off passengers and move on to the next trip or park farther away at a lower expense. Unless car rental companies adapt business models, as there could be less demand for car rental services if AVs are readily available, airport revenue will decline. To offset this, the airport could modify existing structures or create new AV parking facilities to generate additional revenue.

University Parking

Universities will be affected in varying ways depending on parking composition, such as full-time, part-time and commuter students; faculty; and if the university has other facilities, such as research, medical, or a significant number of other events. Some rural universities with limited public transportation options report more than 90% of students have vehicles on campus, while universities in major cities report 0% of student vehicles on campus.

AVs are expected to have less of an effect on university parking until they capture a large share of the market. Younger students already shifted away from owning cars and increasingly rely on car sharing and public transportation to get to their desired destinations. This could lead to a more dramatic shift in university parking. Professors and other staff at universities are likely to stick with their current mode of transportation to work, especially in the early years of AVs.

Opportunities for the Parking Industry to Repurpose Assets

While Fitch does not include recovery analysis in its infrastructure enterprise or project finance ratings, parking assets could evolve or have a second life. Repurposing parking would require ownership or a leasehold interest in the land, which is usually the case for publically owned parking garages and systems. This is not usually the case with concessions where the concessionaire only has rights to cash flows from parking. Some existing car parks already aimed at developing additional revenue streams including car cleaning areas, valet parking services and EV charging points.

Once AVs begin to appear on roadways the business model for parking facilities will likely change. As the demand for parking shifts, garages may be repurposed for other AV uses. Existing and new parking structures could use a portion of the garage as a charging, fueling, battery swap and service station, along with a pick up and drop off location for individuals waiting for an AV to take them to their desired destination. However, the revenue generation potential of these alternative uses is not yet clear.

New parking structures could be designed so they can be repurposed if there is a steep decline in parking demand. Developers are already designing parking garages which can be converted into other uses such as office space. These designs are more expensive to build than conventional parking garages but hedge against potential declines in parking demand. It is also possible that for older garages, especially in prime downtown areas, the land could be redeveloped for a variety of purposes such as retail, office, residential, recreational, or entertainment space.

An example of a parking garage constructed to adapt under circumstances of a decline in parking demand is the Assembly Row parking garage in Somerville, MA. The city partnered with Audi AG to apply emerging technologies including automated parking to ease congestion. Residents can use one of the cars to be transported from home to work and then the car is instructed to park in the garage. The garage was constructed to allow cars to be parked in rows one behind another, which will reduce the area dedicated to parking by about 62%. Ultimately, once the demand for parking declines, the garage was designed to serve as a charging station for AVs and a drop off and pick up hub for AV users.

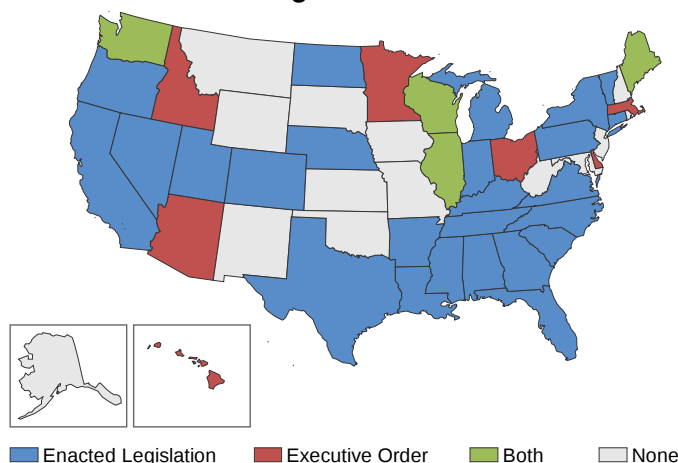
Challenges If Technology Improves Faster Than Expected

AV technology developed rapidly over the past five years resulting in the creation of AV testing programs across the country. These programs allowed fleets to operate as trials in certain states with drivers who can take over the wheel as necessary. Test programs are relatively new and technological improvements are required before AVs can enter the consumer market. A significant acceleration in AV technology could make AVs ready for consumers at an earlier date than projected.

Even with a substantial improvement in technology, other barriers would need to be mitigated in order for AVs to enter the market. State and Federal legislation will play a key role in determining when AVs make their debut. Action was taken at the State and Federal level to enact AV legislation. Currently 29 states and Washington D.C. passed legislation related to AVs and 11 Governors issued executive orders on the matter. The U.S. House of Representatives passed H.R. 3388, the *Safely Ensuring Lives Future Deployment and Research in Vehicle Evolution Act* (SELF DRIVE Act). A similar version of the SELF DRIVE Act is in the U.S. Senate, S. 1885, known as the AV Start bill, passed committee but is held up on the Senate floor.

The U.S. Department of Transportation (DOT) issued the document *Preparing for the Future of Transportation: Automated Vehicles 3.0* to provide guidance for government officials and manufacturers when making policy and AV safety-related decisions. The goal of the document is to provide a flexible framework taking a nonregulatory approach, while simultaneously prioritizing safety. The guidance is designed to evolve as technology advances. Until the proper legislation is enacted at both the State and Federal level, AVs will not be able to enter the market, even if the technology is ready. The proper infrastructure will also need to be in place and all safety concerns need to be addressed before consumers accept AVs.

Governmental Oversight in U.S.



Source: National Conference of State Legislatures.

Fitch's Ratings Approach for Existing and New Parking Assets

Fitch rates parking transactions under our [Rating Criteria for Infrastructure and Project Finance](#). The revenue risk analysis for the asset includes volume-related factors. In the case of parking, these would include the nature of the parking service provided, such as downtown, business, leisure, medical, student, or faculty. Additional factors, such as parking composition, hourly, monthly or annual; third-party, government or private sponsors; economic and demographic fundamentals of the service area; and competing facilities are included.

Price risk takes into consideration the legal and political rate-raising ability of the asset. Fitch factors in infrastructure development and renewal by incorporating management's approach to capital investment and maintenance. This includes planning and funding, which may mean additional capex to adapt to greater usage of AVs. The debt structure assessment focuses on the strength of the security pledge, type of debt and strength of covenants. The assessment also focuses on the composition of payment terms and the strength of covenants to support debt payment, maintain adequate liquidity and limit leverage.

The resiliency of the transaction can be gauged by sensitizing parking growth rates, and/or parking fee adjustments, and factoring in historical trends, pricing framework, and other issuer-specific volume risks. The annual revenue growth rate required to breakeven is one method to determine a parking asset's vulnerability to reduced demand.

Assets that can sustain zero or negative revenue growth and cover debt service are less vulnerable. Additional scenarios assessing the robustness of the transaction, such as the ability to survive 1% to 3% in annual declines beginning in 10 years, will also be developed on a case-by-case basis.

Other factors, such as local and regional infrastructure improvements, including funding availability and political factors may be relevant. Additional competing transportation options, such as public transit and bus service and other geographical factors are also material. On the cost side the ability of an asset to reduce operations, parking spots, operating expenses, adjust fees and potentially reduce long-term lifecycle needs, given declines in usage, will be important.

The table below shows key metrics for Fitch-rated parking entities. The breakeven analysis includes sensitivities to assess vulnerability to declines in parking demand. The analysis does not include management intervention or parking rate increases. Operating expenses grow at inflation rates. Fitch notes public entities with rate-making flexibility may have additional levers to pull in the near term to maintain revenue as compared to a parking concession issuer capping annual rate increases.

Fitch-Rated Parking Assets with Public Ratings

	Philadelphia Parking Authority, PA	Baltimore/ Washington International Airport, MD	Miami Parking, FL	Harrisburg Parking (PEDFA), PA	Bethesda Parking Lot District, MD	Boulder Central Area General Improvement District, CO
(\$ Mil, As of December 2017)						
Parking Type	Airport	Airport	Urban	Urban	Urban, Tax Supported	Urban, Tax Supported
Rating/Outlook	A-/Stable	A/Stable	A/Stable	BBB-/Negative	AA/Stable	AA/Stable
Total Debt	96	126	65	125 (Senior)	33	5.54
Debt Maturity	September 2029	March 2027	October 2039	January 2044	June 2032	January 2023
Rate Covenant (x)	1.50	1.25	1.50	1.25	1.25	1.25
Fiscal 2017 DSCR (x)	2.8	3.3	3.0	2.8 (Senior) 1.3 (Total)	2.3	1.9
Fitch Rating Case Average Coverage (x)	2.5 ^a	3.4 ^a	3.3 ^b	2.6 (Senior) 1.2 ^c (Total)	2.3 ^d	2.4 ^a
Unrestricted Cash Balance	6.7	0.0	16.7	1.4	9.5	8.3
Fiscal 2017 Leverage (x)	2.0	1.8	3.0	7.1 (Senior)	1.7	(0.5)
Rating Case Year Five Leverage (2022) (x)	2.2	0.8	2.4	6.1 (Senior)	0.4	(4.8)
Last DCOH	104	0	346	111	348	534

Breakeven Analysis

Revenue growth breakeven starting in 2028 (%)	(5.1)	N.A. Debt matures in 2027	(4.0)	(2.5)	(20.0)	N.A. Debt matures in 2023
Average DSCR through maturity with a 1% decline in revenue growth per year starting in 2028 (x)	4.4	N.A.	2.9	2.2	3.5	N.A.
Average DSCR through maturity with a 3% decline in revenue growth per year starting in 2028 (x)	3.5	N.A.	2.6	Results in coverage below 1.0	3.3	N.A.

^aFive-year average. ^bTen-year average. ^cSix-year average. ^dNine-year average. PEDFA – Pennsylvania Economic Development Financing Authority. DSCR – Debt service coverage ratio. DCOH – Days cash on hand. N.A. – Not applicable. Note: Operating expenses in breakeven analysis grow at inflation levels. Source: Fitch Ratings.

As we monitor technological advancements, legislative and regulatory progress, and actual usage rates, assumptions will likely change. Given the current stage of development Fitch has not developed a specific time horizon when these parking related assets could be affected. Higher debt service coverage and greater breakeven levels will provide comfort for issuers more vulnerable to risk from AVs and RS.

In our portfolio, Bethesda Parking Lot District in Maryland and Boulder Central Area General Improvement District in Colorado both benefit from tax support, justifying high ratings of 'AA' with Stable Outlooks. This additional security protects these entities from increased demand risk. For highly levered transactions, especially those with bullet debt, structural features such as cash sweep triggers and management strategy to timely delever and maintain high coverage ratios in outer years will mitigate longer-term risk.

Fitch views parking assets as the most vulnerable to changes in demand from AVs but other assets including toll roads and CONRACs will also face challenges. The same factors affecting parking assets, reduced individual car ownership and greater efficiency through RS, could reduce the number of toll paying vehicles.

However, demand for trips will remain and fully AVs could create trips by transporting individuals who are unable to operate a conventional car. Fitch expects AVs' effect on demand for rental cars to be similar to parking assets and less complex than for toll roads. Both large hub and small hub airports in the U.S. developed CONRAC facilities financed with stand-alone special facility debt.

Fitch views CONRACs located in major tourist destinations and markets with less concentrated business districts as less vulnerable to current ground transportation alternatives such as taxis and public transportation. This view holds for AVs but AVs are expected to heighten competitive pressures. Similar to its approach to parking assets, Fitch is considering the effect of AVs on all related transportation assets and will conduct additional analysis on a case-by-case basis.

Certain Issuers Have Better Protection from Demand Risk

Issuers with unlimited legal rate making flexibility are generally in a better position, compared to issuers under a concession agreement. This limits the rate making ability beyond certain predetermined caps, should there be a decline in usage. The asset's franchise strength will also be a key consideration of the resiliency of the asset, as ramp up is expected to vary across the spectrum of parking assets.

Timing and implementation is the biggest unknown. Issuers with shorter debt maturities and other structural features, such as lock-up tests and mandatory prepayment mechanisms, irrespective of debt service coverage ratios or leverage metrics, are in a better position to adjust to the changing landscape.

As detailed above, some airports started to charge a fee to the TNCs to directly offset declines in parking revenue. Airport parking at most airports arguably has the most convenient parking adjacent to terminals and should retain the most pricing power as AV usage ramps up. Airport parking could also serve as an alternative deployment and pickup location for AVs and RS programs. There is some uncertainty whether airports will have the political will to apply TNC fees at a commensurate level to remain revenue neutral.

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