



The Influence of Autonomous Vehicles on Insurers and Ride-Hailing Services

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Abstract

Autonomous vehicles have captured the public's imagination for what they could do to change the way people move from one place to another. Relative newcomers to the auto industry, such as Tesla, Alphabet, and Uber, have been developing software seeking to power fully autonomous vehicles. The implication is that there would be no need for a driver. Driverless vehicles pose a number of issues and opportunities for transportation companies and their affiliate industries such as car insurance companies. Traditional automakers such as Ford and BMW are partnering with both other automakers and technology companies in order to engage synergies and achieve complete automation before their competitors. With this competition underway, there are sectors in the economy whose current business models would be disrupted by autonomous vehicles. One of these is the car insurance industry, which depends on sharing risk with policy holders such as human drivers. This paper delves into the topic of how insurance companies would be affected by a change in this risk-sharing relationship with policy holders. Furthermore, this paper also examines the current status of the ride-hailing industry and how the main service providers are aiming to benefit from autonomous driving technology.

Keywords: autonomous vehicles, insurance, ride-hailing

The Car Insurance Industry: Literature Review

A basic notion in efficient markets is that an increase in the risk of an asset should warrant an equivalent increase in expected returns. Thus, the higher the risk, the higher the investment return an investor could potentially receive. The car insurance industry is predicated on managing risk across a large number of people. The risks accounted for by insurance companies not only involve the individual risk profile of the policy holder, but also a variety of risks inherent in underwriting policies, such as changes in government regulations, tariffs, oil and gas prices, and advancements in technology such as “the development of autonomous or partially autonomous vehicles” (The Progressive Corporation, 2019). While many of these risks will likely remain constant for the foreseeable future, the adoption of autonomous vehicles may lead to a change on the pricing of premiums. If autonomous vehicles are introduced, the question at hand will be: if autonomous vehicles lead to fewer accidents and thus lower risk and lower

premiums, will insurers be significantly impacted? In a widely cited report released in 2015, the National Highway Traffic Safety Administration (NHTSA) showed that human error was the critical reason for 94% of car accidents in the US with a 2.2% margin of error. These errors include distracted driving, speeding, and sleeping while driving. The remaining percentage is attributed to vehicle malfunctions and environmental conditions (NHTSA, 2015). If people are relieved from driving, the frequency of accidents may decrease.

A team of Deloitte Consulting researchers who have developed a model of possible future car insurance premiums under various conditions has taken the view that if autonomous vehicles did indeed decrease the number of accidents, then risk premiums would fundamentally change. The first variable in the Deloitte model was a “steady state.” For the steady state model, researchers assumed that all the risks contributing to premium prices stayed on their current trajectory, including inflation and the use of traditional cars as the mainstream mode of transportation. The steady state projected an increase in premium prices along 2030 and 2040 from the 2015 levels. In contrast, a model that introduced autonomous vehicles changed the premium prices forecast sharply downward, showing a decrease of 33% in premium prices on 2030 and a 70% decrease on 2040 when compared to its “steady state” equivalent in the same year. Furthermore, the model projects that the prices of premiums in 2040 would be lower than those of 2015 even before adjusting for inflation. The factors contributing to this decrease are grouped into two categories. First, there are factors affecting the frequency of claims. These are the number of accidents and the rate of insurance fraud. The model assumes that self-driving cars will both reduce the number of accidents and the rate of insurance fraud at an increasing pace. Self-driving cars, equipped with cameras and sensors around the entire car, would be able to accurately and factually record the entirety of the accident, thus greatly reducing the possibility of fraud and fault disputes and decreasing the processing costs of claims, called loss-adjustment expenses (LAEs). Second, self-driving cars would affect the monetary losses of accidents. The model assumed that accidents would be less damaging because autonomous vehicles would engage safety systems such as automatic braking and reduce the impact with other objects. However, the benefits of less-severe crashes would be partially offset by higher repair costs of more complex vehicles. (Deloitte US, 2017).

The basic premium underwriting that the Deloitte team used was taken from the Casualty Actuarial Society's Basic Ratemaking publication:

$$\text{Premium} = \text{Losses} + \text{LAE} + \text{Underwriting Expenses} + \text{Underwriting Profit}$$

As we can see from this equation, insurance premiums must cover the expected losses that are incurred in claims and also cover expenses such as loss-adjustment expenses (LAEs) and underwriting expenses. LAEs are the costs of paying employees to process claims, while underwriting expenses are costs associated with paying insurance agents and brokers for generating the policies (Werner, 2016). Insurance companies collect premiums from customers to cover their immediate expenses and invest both their underwriting profit and their unpaid claims. I assume that autonomous vehicles would not significantly alter insurance companies' investment strategy. Based on this equation, if the number of accidents went down, then the losses would also go down and the premium would be reduced. How might insurers adapt their LAEs and underwriting expenses? The main question at hand concerning car insurers is whether or not autonomous vehicles (AVs) are actually safer than traditional cars. Current AV testing data may provide a preliminary indication on their safety.

First, let us evaluate the safety component of self-driving cars. Since AVs have neither achieved widespread adoption nor achieved level 5 automation, which is the highest level of automation that requires no driver input, data on the safety of self-driving cars are limited and will require further study. However, this paper uses current information as a proxy on the safety potential of autonomous vehicles. It is important to note that there are a number of limitations to this approach. Professor Lionel Robert Jr., of the University of Michigan, spoke about the difficulty of measuring AV metrics today to determine if AVs are safer than manual cars. First, using the number of accidents per mile driven as the primary metric to determine safety, we can see which type of car tends to have more accidents. However, there are many more manual cars on the road today than AVs, and the latter's record has fewer data points available; a single accident for AVs would drastically change the average rate of accidents. Since there are 5 different levels of automation, we would also need to define which level of automation counts as an AV and which does not (Robert, 2019). The best solution to these possible confounding variables would be to re-examine the topic when there exists both level 5 automation and a wide array of data on AVs in different environmental conditions for several years. The best comparison with manual cars would happen when there is a significantly higher number of AVs

on the road. For the purposes of this paper, AVs today are those vehicles at level 4 automation, which, as defined by the NHTSA, feature “[a]n Automated Driving System (ADS) on the vehicle [that] can itself perform all driving tasks and monitor the driving environment – essentially, do all the driving – in certain circumstances. The human need not pay attention in those circumstances” (NHTSA, 2020). These types of vehicles can change lanes, change speed, and make turns without driver intervention, but the driver is required to stay alert at all times and be ready to take over the steering wheel at any time. The data available on self-driving cars are limited. The State of California requires all companies testing autonomous vehicles on California roads to register and report all collision accidents and all disengagements on the course of a test run. Disengagements are a transfer of control from the vehicle’s artificial intelligence to the driver: a shift from autonomous driving to manual driving (Favaro et al, 2017).

There are a number of issues with using infrequent disengagements as a proxy for safety. First, disengagements do not necessarily mean that an accident would have occurred if the driver did not take control of the vehicle, nor do they mean that a particular company or car is safer than the other, since disengagement data is limited to California where some companies may choose not to conduct testing. Instead, some companies may choose to conduct the bulk of their tests outside the state in an effort to reduce the number of engagements reported to the public (Hawkings, 2020). If more states required reporting disengagements, we would have a more accurate picture of each company’s total performance. Using California accident reports for AVs from 2014 to 2017, Dr. Francesca Favaro stated that 62% of accidents involving AVs resulted from other cars who rear-ended the AV. This is double the proportion of manual cars who are rear-ended, at 30%. She says that these proportions “suggest that AV technology is capable of preventing all other accident typologies effectively, leaving rear-end collisions with the AV in front the most important failure scenario to be addressed next by manufacturers” (Favaro, 2017). However, for the analysis to support the conclusion that AVs are indeed safer, we would need to possess data on a higher number of AVs being used in natural conditions in a variety of states.

Ride-Hailing Companies and AV Arrangements

Ride-hailing companies today function as intermediaries between drivers and commuters through a smartphone application. They have changed the transportation landscape substantially. People can summon a driver to their exact location and indicate their destination through the app before confirming the ride. Their service has become a ubiquitous channel of transportation in

the United States and the world. However, the two main ride-hailing companies, Uber and Lyft, have been unprofitable even at their IPO day (Dey, 2019). This is not uncommon; according to data collected by Professor Jay Ritter of the University of Florida, 74% of companies executing IPOs in 2019 have had negative earnings per share (Ritter, 2019). It is clear, then, that many companies are comfortable with presenting a growth proposition to investors: a vision of a future status where ubiquity could be leveraged into lowering costs and increasing revenues. The value of growth companies involves changing some assumption about the future that will purportedly switch the company's income-producing ability. Uber, for example, says that AVs could "deliver a paradigm shift in the cost structure of vehicle rides such that Personal Mobility products can ultimately replace personal vehicle ownership and usage" (Uber S-1, 2019).

Uber takes a percentage made from transactions between Uber drivers and riders. This is known as the *take rate*. Its main asset is its eponymous ride-hailing app, whose strength is derived from the size of its network. The more people use the app, the higher Uber's leverage will be in regard to pricing. However, the ride-hailing market is highly competitive. A research report by CB Insights highlights three challenges for Uber that prevents it from achieving a positive net income: One, Uber is engaging in market development, working to settle into new markets and incurring costs to achieve regulatory approval and clear logistical hurdles in each city. Two, Uber's main service is highly price-sensitive, and riders could easily switch to another provider that offered the lowest price. For this reason, Uber cannot raise its prices without losing market share to competitors like Lyft. Third, Uber must spend cash to retain drivers in a high-turnover industry and to advertise its service to obtain new drivers (CB Insights). Therefore, Uber's main challenges are the following:

1. Market development expenses
2. Price pressure from competitors
3. Driver retention and marketing

Those items account for Uber's operating expenses and pricing limits. Uber also is using its cash flows to invest heavily in R&D to develop autonomous vehicles in its Advanced Technologies Group, or ATG. Uber's business segments all have a negative segment-adjusted earnings before interest, taxes, depreciation and amortization (EBITDA) except for the Rides segment, which has seen an increase in its EBITDA each year, as seen on Figure 1. However, this does not mean that Uber's Rides segment is profitable. In addition to each business segment,

Uber's 2019 10-K shows a "Corporate G&A and Platform R&D" line item, which is an expense account not attributed to any specific segment but includes costs that are shared among all segments. This expense account is large enough to negate the EBITDA for the Rides segment. Therefore, Uber remains unprofitable as of early 2020.

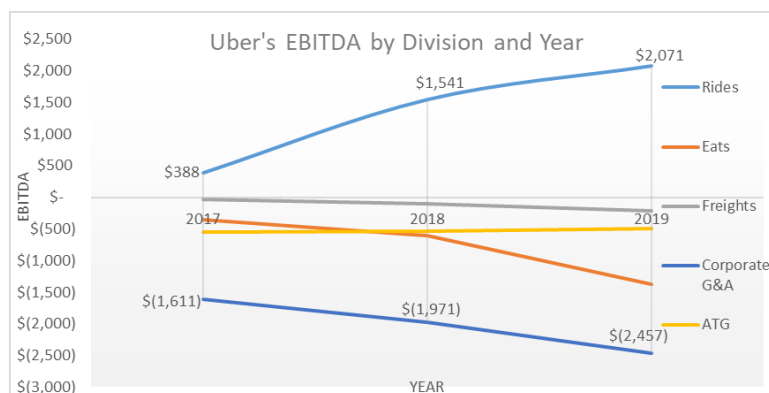


Figure 1. Uber's EBITDA by Segment. Created from Uber's 2019 10-K data. Figures in millions.

Uber's business involves no capital investments in equipment. Rather, Uber outsources both the vehicles and the labor required to perform its ride service. Essentially, Uber's service involves no long-term commitment from its contractors' labor and vehicles. Additionally, Uber has a high turnover rate. According to research by Cook et al. (2020), 68% of Uber drivers leave the app after 6 months. For this reason, Uber must continually spend cash on marketing and promotions to attract new drivers. Professor Aswath Damodaran, of NYU, has a collection of macroeconomic and microeconomic financial data for which to create valuation models of Uber and other companies. Professor Damodaran's latest valuation of Uber, calculated shortly after the company's IPO in 2019, used Damodaran's estimates of the cost of capital, terminal value, taxes, market growth, capital expenditures, and other metrics. He used a discounted cash flow valuation to arrive at Uber's present value per share, estimated at \$54.52. (Damodaran, 2019). It is important to note several characteristics of his model. First, Professor Damodaran estimates a 10% growth rate for the ride-hailing market and also estimates that Uber will achieve a 30% market share in the next few years. Perhaps the most significant item in the model is that Uber achieves a positive operating income in 2023. Professor Damodaran's valuation and Uber's 2019 10-K were the primary sources for the model created by this author specifying how Uber's valuation would change under a scenario analysis involving autonomous vehicles.

Uber's Potential Future Under Automation

Uber must compete with other ride-hailing companies such as Lyft, and that is unlikely to change even with the advent of self-driving cars. Furthermore, other participants are likely to enter the market, such as Waymo, which possesses the complete financial backing of Alphabet and whose software could easily be leveraged into an app in the Google suite.

A large part of the prospects of survival for ride-hailing companies relies on the market size of the industry. The estimated revenues for the global ride-hailing market was \$153.561 billion in 2018 (Péter, 2019). However, the size of the market could increase greatly if more users switched from using personal cars to ride-hailing. Uber's current global market share in the ride-hailing industry is about 33%, obtained by dividing Uber's global gross bookings for the Rides division in 2018 by the total global revenues in the ride-hailing industry. The ride-hailing industry includes Uber, Lyft, and smaller ride-hailing competitors worldwide. The model keeps Uber's market share at 33% throughout the analysis. This is compared to Professor Damodaran's valuation, which assumes a 30% market share.

In Uber's prospectus, the company states that it considers itself a participant in the personal mobility industry, which involves a total addressable market (TAM) of 11.9 trillion miles per year. The personal mobility industry, as defined by Uber's S-1, includes essentially all modes of transportation, such as the subway, ride-hailing, personal cars, taxis, and buses. The addressable market is the potential market that Uber's services could reach, which encompasses "all passenger vehicle miles and all public transportation miles in all countries globally in our TAM, including those we have yet to enter" (Uber S-1, 2019). With this statement, Uber conveys the belief that it can expand its core Rides business to compete with public transportation and private car ownership. The company views itself as a possible alternative to individual car ownership. This will be one of the factors in a scenario analysis of Uber.

Scenario Analysis

In order to estimate how autonomous vehicles may impact the ride-hailing industry, a scenario analysis was performed with three different factors: an increase in the ride-hailing market, an increase in Uber's *take rate*, and a reduction in Uber's operating costs. Each factor's present value was recorded. The take rate is defined as Uber's share of the revenues for each booking made on its app. Several assumptions made in the model stemmed from Professor Damodaran's own estimates to create a base. In this author's model, the Alfonso model, Uber's

market share is capped at 33.55%, and the growth rate of the market is 11.61% until 2030, when it then grows at a rate of 8% onward. The market sizes were determined from the Statista Market Outlook report up to its last estimate on 2024, where the market's revenues would be \$355,799 million. The growth rate of expenses is held at 9% per year throughout the analysis. The model utilizes three junctions: 2030, 2035, and 2040. Each of the three factors is tested independently at each junction to estimate how they could change Uber's value depending on how late they arrive. For example, Uber's take rate factor could activate in 2030, or 2035, or 2040, which would change the company's cash flows and thus its present value. For the cost of capital, the model uses Professor Damodaran's estimates and then the model carries on Damodaran's final weighted average cost of capital throughout the rest of the cash flows. I will use these assumptions to form the steady state and compare it with different scenarios. . In the steady state, the present value of Uber's equity is \$62,468.75 million, and its stock price is \$54.70 per share with 1,142 million shares. These estimates are close to Professor Damodaran's valuation of Uber.

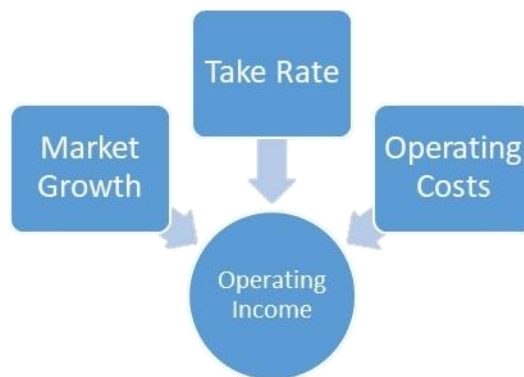


Figure 2. The three factors used to change Uber's future operating income assumptions.

Factor 1: Market Growth

This factor involves the ride-hailing industry capturing 5% of the personal mobility industry's total addressable market outlined by Uber, which is defined as the average gross booking per mile multiplied by the total number of miles driven by vehicles worldwide. In other words, the ride-hailing industry would grow to cover 5% of all transportation miles worldwide, which would be up from Uber's estimated 1%. The global market of ride-hailing could get a boost from consumers utilizing ride-hailing services as a substitute for personal car ownership. According to this study by Martin and Shaheen (2019), a survey conducted with participants in the car-sharing industry found that households that adopted carsharing halved the number of cars

that they owned. This survey suggests that people would forgo personal car ownership in favor of a shared mobility option. In this model, there would be an event where 5% of the world's drivers would switch their cars for ride-hailing, increasing the market size and thus Uber's revenues. The revenues are modeled by a percentage of the total number of miles driven worldwide multiplied by the average Uber gross booking per mile. According to Uber's S-1 filing, in 2018, the company had \$41.5 billion in gross booking revenues from ride-hailing, and users drove a total of 26 billion miles with Uber.

$$\text{Average Gross Booking Per Mile} = \frac{\$41.5 \text{ billion}}{26 \text{ billion miles}} = \$1.60 \text{ per mile}$$

This figure would grow with inflation at about 2% per year. According to Uber's prospectus, the addressable market involves 4.7 trillion miles involving trips less than 30 miles per trip. The model shows Uber's change in revenues if the ride-hailing market increased to 5% of 4.7 trillion miles.

Results

Table 1. Effects of Market Enlargement on Present Value due to a Reduction in Car Ownership

Year the Factor is Introduced	New Present Value of Equity	Original Present Value of Equity	Additional Value of Equity	Additional Value per Share
2030	\$308,778.39	\$62,468.75	\$246,309.64	\$215.68
2035	\$216,267.75	\$62,468.75	\$153,799.01	\$134.68
2040	\$154,789.26	\$62,468.75	\$92,320.51	\$80.84

As we can see, the earlier the market enlarges, the higher the present value of Uber will be. If the ride-hailing market captured 5% of the addressable market, Uber's present value per share would increase by \$215.68 if it were introduced in 2030 and \$80.84 if it were introduced in 2040.

Factor 2: Take Rate

Uber's take rate is the proportion of the revenue the company receives out of each booking generated on its app. stated in its 2018 10-K that its take rate was 21%. Therefore, each time a user books a ride, 21% of the price of the ride is paid to Uber and the rest goes to the driver. In this scenario, Uber's take rate increases as a result of autonomous vehicles. This factor assumes

that Uber would be able to negotiate a partnership with automakers, who would lease the autonomous vehicles to Uber. Realistically, Uber would be able to attain a new take rate only after rounds of negotiations. This model assumes that Uber would be able to increase its take rate to 25-30%. A sensitivity analysis is conducted in 1% intervals and the average increase in present value is taken.

Results

Table 2. Sensitivity Analysis on the Take Rate and its Effects on Present Value. The Increase Begins in 2030.

New Take Rate	New PV of Equity	Original PV of Equity	Additional PV of Equity	New Stock Value per Share	Original Stock Price	Additional Value per share
25%	\$127,968.25	\$62,468.75	\$65,499.50	\$112.06	\$54.70	\$57.36
26%	\$144,343.13	\$62,468.75	\$81,874.38	\$126.40	\$54.70	\$71.69
27%	\$160,718.00	\$62,468.75	\$98,249.26	\$140.73	\$54.70	\$86.03
28%	\$177,092.88	\$62,468.75	\$114,624.13	\$155.07	\$54.70	\$100.37
29%	\$193,467.76	\$62,468.75	\$130,999.01	\$169.41	\$54.70	\$114.71
30%	\$209,842.63	\$62,468.75	\$147,373.88	\$183.75	\$54.70	\$129.05
Average	\$168,905.44		\$ 106,436.69			\$93.20

If the take rate is increased starting on 2030, we would see that Uber's value per share would increase dramatically. Uber's revenues are highly sensitive to a 1% change in its take rate. Uber's current take rate is 21%. If Uber could negotiate a higher take rate by partnering with AV manufacturers instead of drivers, its revenues could change substantially. Table 3 shows the average increase in present value when the take rate increase is introduced in 2030, or 2035, or 2040, and the results are noted.

Table 3. Average Increase in the Present Value of Equity by Increasing the Take Rate

Year the Factor is Introduced	Average New PV of Equity	Original PV of Equity	Average Additional PV of Equity	New Stock Value per Share	Original Stock Price	Additional Value per share
2030	\$168,905.44	\$62,468.75	\$106,436.69	\$147.90	\$54.70	\$93.20
2035	\$150,915.40	\$62,468.75	\$88,446.66	\$132.15	\$54.70	\$77.45
2040	\$133,123.93	\$62,468.75	\$70,655.18	\$116.57	\$54.70	\$61.87

It is clear that Uber's present value would be higher if the factor were introduced earlier. Although the increase is not as high as that of factor 1, Uber's value of equity would more than

double if it were to increase its take rate. If the company is to increase its operating profit, increasing its take rate may be key. As the market grows, increasing the company's take rate becomes more important. The greater the size of the market, the higher the dollar value of a 1% increase in the take rate will be. Autonomous vehicles may, after a transitional period, allow ride-hailing companies to achieve a higher take rate. If companies like Uber were to increase their take rate, their revenues would increase significantly, which may allow ride-hailing companies to become sustainable in the long term.

Factor 3: Cost Reduction

Under the third scenario, Uber's expenses would be reduced through vastly reducing its marketing and retention costs for drivers. This model assumes that Uber could achieve a 5% to 25% permanent reduction in operating costs by achieving economies of scale after reducing its costs related to handling driver turnover by deploying autonomous vehicle fleets and reducing its need for drivers. Uber would need to obtain a state license to operate autonomous vehicles in order to lawfully deploy AVs for consumers. I tested this reduction by introducing it in 2030, or 2035, or 2040, and the increase in present value is recorded.

Results

Table 4. Average Increase in the Present Value of Equity by Reducing Costs by 5 to 25%.

Permanent Reduction in Total Costs	Average New PV of Equity	Original PV of Equity	Average Additional PV of Equity	Average New Stock Value per Share	Original Stock Price	Additional Value per share
2030	\$107,908.84	\$62,468.75	\$45,440.09	\$94.49	\$54.70	\$39.79
2035	\$100,654.06	\$62,468.75	\$38,185.32	\$88.14	\$54.70	\$33.44
2040	\$93,140.99	\$62,468.75	\$30,672.24	\$81.56	\$54.70	\$26.86

The additional value resulting from reducing costs is lower than that achieved by the other factors. However, it is important to note that this factor could be modified internally by the company, making the reductions a more achievable goal. As stated previously this reduction may come about as a result of cutting driver retention and marketing costs.

Summarized Results

Table 5. Summarized Results of the Scenario Analysis

Year the Factor is Introduced	Original PV of Equity	Avg PV Factor 1: Market Enlargement	Avg PV Factor 2: Increased Take Rate	Avg PV Factor 3: Reduced Costs	New PV of Equity	New Value Per Share
2030	\$62,468.75	\$246,309.64	\$106,436.69	\$45,440.09	\$460,655.18	\$403.38
2035	\$62,468.75	\$153,799.01	\$88,446.66	\$38,185.32	\$342,899.73	\$300.26
2040	\$62,468.75	\$92,320.51	\$70,655.18	\$30,672.24	\$256,116.68	\$224.27
Per Share						
2030	\$54.70	\$215.68	\$93.20	\$39.79		\$403.38
2035	\$54.70	\$134.68	\$77.45	\$33.44		\$300.26
2040	\$54.70	\$80.84	\$61.87	\$26.86		\$224.27

Conclusion

The ride-hailing industry may be changed significantly by three future events: An acceleration of market growth, an increase in the industry's take rates, and a reduction in costs. These events may not happen in unison, but it is important to note that there is an early indication that autonomous vehicles may make the industry profitable and sustainable in the long term. The industry has a number of issues to solve before it achieves those results, such as achieving regulatory approval, negotiating rates with automakers, and changing consumer attitudes towards ride-hailing. Insurance companies will have to adjust their cost structure and revenues as well. By introducing autonomous vehicles, the ride-hailing industry will face issues of liability that may be decided by the courts, and the industry should work to accompany an increase in accident-related costs with a sufficient decrease in the rate of accidents if the industry is to remain sustainable in the long term.

References

- CBS Insights. (n.d.) How Uber Makes - And Loses - Money. Retrieved from <https://www.cbinsights.com/research/report/how-uber-makes-money/>
- Cook, C., Diamond, R., Hall, J., List, J., & Oyer, P. (2020, May). The Gender Earnings Gap in the Gig Economy: Evidence from over a Million Rideshare Drivers. Retrieved from <https://web.stanford.edu/~diamondr/UberPayGap.pdf>

- Damodaran, A. (2019). Uber's Coming out Party: Personal Mobility Pioneer or Car Service on Steroids? Retrieved from <http://aswathdamodaran.blogspot.com/2019/04/ubers-coming-out-party-personal.html>
- Deloitte US. (2017, September 2017). Future of automotive insurance in the new mobility ecosystem. Retrieved from <https://www2.deloitte.com/us/en/pages/consulting/articles/automotive-insurance-future-mobility-ecosystem.html>
- Dey, E. (2019, September). Unprofitable Companies Are Raising the Most IPO Cash Since the Dot-Com Era. *Bloomberg*. Retrieved from <https://www.bloomberg.com/graphics/2019-unprofitable-ipo-record-uber-wework-peloton/>
- Favarò, F. M., Nader, N., Eurich, S. O., Tripp, M., & Varadaraju, N. (2017, September 20). Examining accident reports involving autonomous vehicles in California. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5607180/>
- Hawkins, A. J. (2020, February 26). Everyone hates California's self-driving car reports. *The Verge*. Retrieved from <https://www.theverge.com/2020/2/26/21142685/california-dmv-self-driving-car-disengagement-report-data>
- Martin, Elliot, and Shaheen, Susan. (2011). The Impact of Carsharing on Household Vehicle Ownership, Retrieved from <http://reconnectingamerica.org/assets/Uploads/access38carsharingownership.pdf>
- NHTSA. (2015). Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey. Retrieved from <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115>
- NHTSA. (2020). Automated Vehicles for Safety. Retrieved from <https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety>
- Péter, M. (2019, July 29). Ride Hailing market - Revenue worldwide in 2023. Retrieved from <https://www.statista.com/forecasts/891250/online-revenue-in-the-ride-hailing-market-worldwide>
- Ritter, Jay. (2020). Initial Public Offerings: Technology Stock IPOs. Retrieved from <https://site.warrington.ufl.edu/ritter/files/IPOs2019Tech-Stock.pdf>
- Robert, L. P. (2019, May 1). Are automated vehicles safer than manually driven cars? Retrieved from <https://link.springer.com/article/10.1007/s00146-019-00894-y>
- The Progressive Corporation. (2019). Form 10-K 2019. Retrieved from SEC EDGAR website <https://www.sec.gov/ix?doc=/Archives/edgar/data/80661/000008066120000006/pgr-20191231x10k.htm>
- Uber. (2019). Form S-1. Retrieved from SEC EDGAR website <https://www.sec.gov/Archives/edgar/data/1543151/000119312519120759/0001193125-19-120759-index.htm>
- Uber. (2020). Form 10-K. Retrieved from SEC EDGAR website <https://www.sec.gov/ix?doc=/Archives/edgar/data/1543151/000154315120000010/fy2019q410kfinancalst.htm>

Werner, G., & Modlin, C. (2016, May). Basic Ratemaking. Retrieved from
https://www.casact.org/library/studynotes/Werner_Modlin_Ratemaking.pdf