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The Evolving Landscape of Urban Mobility: A Case Study of Autonomous Vehicles and Traditional Taxis in New York City



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by

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I hereby recognize and pledge to fulfill my responsibilities as defined in the Honor Code and to maintain the integrity of both myself and the College as a whole.

Acknowledgements

بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

I dedicate this degree and milestone to my mother, whose unwavering support and love have been the foundation of my journey. Without you, I wouldn't be where I am today. Every success I've achieved, and all those yet to come, are a testament to your guidance and influence. Thank you, Mama. I love you.

As I stand here today, I am filled with gratitude and love for the incredible people who have shaped my journey. I would like to take this moment to express my heartfelt thanks to those who have been pillars of strength and inspiration in my life.

سب سے پہلے، میں اپنے والد کا شکریہ ادا کرنا چاہتا ہوں، ایک ایسے شخص جن کی بے غرضی اور ہمارے خاندان کے تئیں لگن حوصلہ افزائی اور راحت کا مستقل ذریعہ رہی ہے۔ دوسروں کو اپنے سامنے رکھنے کے لئے آپ کے غیر متزلزل عزم نے مجھے قربانی اور محبت کا حقیقی مطلب سکھایا ہے۔ میں ان گنت قربانیوں کا ہمیشہ شکر گزار ہوں جو آپ نے ہمارے لئے دی ہیں، دیر رات اور صبح سویرے، ان اوقات کے لئے جب انہوں نے اپنے خوابوں کو روک دیا تاکہ ہم ہمارے خوابوں کا تعاقب کرسکیں۔ اس طرح کے غیر معمولی رول ماڈل ہونے اور مجھے یہ دکھانے کے لئے کہ مقصد اور لگن کی زندگی گزارنے کا کیا مطلب ہے، آپ کا شکریہ، والد. تیری محبت اور رہنمائی ہر طوفان میں میری پناہ گاہ رہی ہے اور میں ہمیشہ تیرا مقروض رہوں گا۔

Next, I want to extend my deepest gratitude to my brother Hassan. He is not just my sibling; he is my constant motivator. His unwavering determination and perseverance have taught me the value of hard work and the importance of never giving up on my dreams. Hassan, your presence in my life has been a blessing beyond measure. May God bless you and continue to guide you on your path. I am so proud to call you my brother.

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Summary of AI Use by Author

In preparing this paper, I employed artificial intelligence (AI) tools, specifically ChatGPT to refine technical aspects of the work. AI assistance was strategically limited to enhancing clarity, ensuring accuracy, and improving formatting, without compromising the originality of my ideas or arguments. A key application of AI was in the integration of scholarly articles, where it helped to accurately summarize and properly cite key concepts and findings from academic sources. This approach allowed me to uphold academic integrity while leveraging technology to improve the overall technical quality of the paper.

AI was incorporated into the writing process in the following ways:

- Eliminating Redundancy and Ensuring Unique Insights: Sections were refined with prompts like: "Remove repetition of ideas and ensure all concepts are unique," and "Ensure no insights are duplicated across chapters," streamlining the content and maintaining consistency throughout the paper.
- Formatting References: All sources were formatted into APA style using the prompt: "Using the sources provided, turn into APA format, in alphabetical order," ensuring correct formatting and systematic organization of references.
- Summarizing Content: Sections were condensed with prompts like: "Combine these paragraphs into one cohesive section without losing key points," and "Summarize this section while maintaining all critical information," helping to reduce length while retaining essential details.

The use of AI was strictly limited to these functions, and the core ideas, analysis, and conclusions remain my original work. This approach reflects my commitment to academic integrity while utilizing technology to enhance the technical quality of the paper.

Abstract

This study examines the disruption of the New York City taxi industry, focusing on Uber's impact and the potential effects of autonomous vehicles (AVs). Uber's disruption involved circumventing traditional taxi regulations by connecting passengers with drivers via a mobile app, which led to plummeting medallion values and increased competition for drivers. The potential effects of AVs include reduced operating costs, improved safety, and reshaping regulations and market dynamics.

Market theories, such as the Contestable Market Theory, the Two-Sided Market Theory, Metcalfe’s Law, and Creative Destruction, are used to analyze these changes. Additionally, Porter's Five Forces to analyze the competitive intensity within the industry.

To collect empirical data for this analysis this study employs market theory analysis, stakeholder interviews, and data evaluation to provide insights into the evolving transportation landscape and addresses the central research question: How will autonomous vehicles (AVs) impact the Taxi and Limousine Commission (TLC) market, drawing on lessons from Uber's disruptive entry?

Chapter 1: Introduction

1.1 History

The taxi industry in New York City has undergone a remarkable transformation over the past century, shaped by technological advancements, regulatory frameworks, and market disruptions. From its humble beginnings with horse-drawn carriages to the advent of gasoline-powered cabs, the rise of ride-hailing platforms like Uber, and now the looming introduction of autonomous vehicles (AVs), the industry's history reflects the broader evolution of urban transportation. To fully understand the current state of the industry and its future trajectory, it is essential to explore its historical roots, pivotal moments of disruption, and the challenges posed by emerging technologies.

In the late 19th and early 20th centuries, New York City relied primarily on horse-drawn carriages for transportation. These carriages were slow, inefficient, and often caused significant congestion on the city's streets. As technological advanced in the early 1900s, new forms of transportation began to emerge. In 1907, Harry N. Allen introduced gasoline-powered taxicabs imported from France, marking a turning point in urban mobility. These new taxis were faster, more reliable, and better suited to meet the demands of a rapidly modernizing city. However, as the popularity of taxis grew, so did challenges such as legal disputes over licensing.

By the 1930s, New York City's taxi industry was chaotic and oversaturated, with unregulated competition leading to declining service quality and economic instability. To address these challenges, the city passed the Haas Act in 1937, introducing the medallion system, which required taxis to have a physical license - known as a medallion - to operate legally. This system

capped the number of taxis on the road, ensuring better regulation and safety standards while stabilizing the market. Over time, medallions became highly valuable due to their scarcity, transforming from simple $10 licenses into assets worth hundreds of thousands - and eventually millions - of dollars by the late 20th century. In 1971, the New York City Taxi and Limousine Commission (TLC) was established to oversee medallion taxis and other “for-hire vehicles”, playing a critical role in regulating fares, licensing drivers, and maintaining safety standards in one of the world’s busiest transportation systems.

Throughout much of the 20th century, taxis became an iconic part of New York City’s identity. The entry of Uber into New York City marked a shift in urban transportation. Unlike traditional taxis bound by medallion regulations and street-hail operations, Uber introduced a ride-hailing platform that connected passengers with drivers using their personal vehicles via a mobile app. This new model bypassed many regulatory constraints imposed on traditional taxis while offering lower fares and greater convenience for riders. Uber’s rapid growth disrupted long-standing market dynamics almost overnight.

For traditional taxi operators, Uber’s arrival was devastating. Medallion values plummeted as demand shifted toward ride-hailing services. Many medallion owners who had taken out loans to purchase their licenses found themselves unable to compete financially or repay their debts. Meanwhile, taxi drivers faced increased competition for passengers and declining incomes as Uber expanded its reach across all five boroughs. The disruption also altered passenger behavior; instead of relying on yellow cabs in tourist-heavy areas like Midtown Manhattan or near airports,

riders began using Uber for trips to parks, residential neighborhoods, and other destinations previously underserved by traditional taxis.

As New York City continues to grapple with Uber's impact on its transportation landscape, another wave of disruption is on the horizon: autonomous vehicles (AVs). Uber has made significant investments in autonomous vehicle (AV) technology to position itself as a leader in the future of transportation. AVs represent a revolutionary leap forward in transportation technology. Using advanced sensors, cameras, and artificial intelligence systems, these self-driving cars are designed to navigate roads without human intervention. For the taxi industry - and urban mobility more broadly - AVs promise numerous benefits but also pose significant challenges.

One of the most compelling advantages of AVs is their potential to reduce operating costs by eliminating human drivers. Without labor expenses or limitations like driver fatigue, AV fleets could provide 24/7 service at lower prices for consumers while increasing efficiency across city streets. Additionally, AVs are expected to improve safety by reducing accidents caused by human error - currently one of the leading causes of traffic fatalities worldwide.

Understanding today's evolving transportation landscape requires an appreciation for its historical context - from horse-drawn carriages to gasoline-powered taxis regulated by medallions; from Uber's disruptive entry into New York City's streetscape to the imminent arrival of autonomous vehicles poised to redefine mobility once again. As New York City looks

toward an uncertain future shaped by AVs and other emerging technologies, it holds valuable lessons about resilience and adaptation in an ever-changing world.

1.2 Overview

This study investigates the disruption Uber introduced into the transportation sector more specifically, the traditional taxi and limousine services. Additionally, the paper highlights the prospective effects of AVs on industry operations, regulations, and market dynamics. The study employs market theory analysis, stakeholder interviews, and data evaluation to provide insights into the evolving transportation landscape.

1.3 Background and Motivation

The transportation sector is on the cusp of reform with autonomous vehicle technology advancing. While AVs promise numerous benefits, including increased safety, reduced traffic congestion, and enhanced mobility options, their widespread adoption could disrupt established business models and regulatory frameworks within the “for-hire” transportation industry. The TLC now faces upheaval as Uber's entry serves as a crucial case study for understanding technology-driven disruption in the transportation market.

1.4 Research Question

The central research question driving this study is: *How will autonomous vehicles (AVs) impact the Taxi and Limousine Commission (TLC) market, drawing on lessons from Uber's disruptive entry?* This paper explores how AVs might reshape the TLC-regulated transportation landscape in New York City. Subsidiary questions delve into identifying market theories that can explain AVs' potential effects on the TLC market, analyzing how Uber's disruption offers insights for managing AV integration, and assessing the implications for key stakeholders, including drivers, passengers, and the TLC itself. Together, these questions aim to provide an understanding of how AVs could transform urban mobility and regulatory frameworks in one of the world's most complex transportation ecosystems.

1.5 Theoretical Framework

This research integrates several economic theories and models to analyze the potential impact of autonomous vehicles (AVs) on the Taxi and Limousine Commission (TLC) market. The Contestable Market Theory, introduced by William Baumol in 1982, provides a framework for understanding how AVs might disrupt the TLC market by lowering entry barriers. He noted that such markets are characterized by "costless entry and exit, where entrants encounter no obstacles in terms of production techniques or perceived product quality relative to incumbents" (Brätland & Robert L. Bradley, Jr., 2004; Baumol 1982). This theory is particularly relevant given AVs' potential to transform the transportation industry by enabling new players to challenge traditional operators.

The Two-Sided Market Theory, developed by Jean-Charles Rochet and Jean Tirole in 2003, further informs this analysis by explaining how platforms create value through interactions between two distinct user groups. Rochet and Tirole stated that a platform serves two types of users, each benefiting from the presence of the other group, creating interdependent demand (Rochet, J.-C., 2003). This model is critical for understanding how ride-hailing platforms like Uber operate and how the introduction of AVs could reshape these dynamics by maximizing value between drivers and passengers.

Metcalfe's Law, proposed by Robert Metcalfe in 1980, highlights the exponential growth of network value as more users join. Metcalfe asserted that "the systemic value of compatibly communicating devices grows as a square of their number" (Chen, 2023). This principle is essential for evaluating how widespread adoption of AVs could enhance the value of mobility networks, potentially creating a more interconnected and efficient transportation ecosystem. Finally, Joseph Schumpeter's concept of Creative Destruction offers a lens through which to view AVs as a transformative force in the TLC market. Schumpeter described this process as "the essential fact about capitalism... It incessantly created new demand for capital good" (Schumpeter, 1942). AVs represent an innovation capable of disrupting traditional taxi operations and replacing outdated systems with more advanced technologies.

Now that Uber is getting involved in Avs together, these theories provide an essential framework for examining how AVs might reshape the TLC market by challenging existing structures, enhancing network effects, and driving innovation through disruption.

1.6 Methodology

This study adopts a mixed-methods approach, integrating both qualitative and quantitative methods to provide an analysis of the impact of autonomous vehicles (AVs) on the Taxi and Limousine Commission (TLC) market. Qualitative data will be gathered through interviews with key stakeholders, these interviews will offer valuable insights into the anticipated challenges and opportunities associated with AV adoption. Quantitative analysis will focus on data related to ridership, revenue, and market share to evaluate the effects of Uber's entry into the TLC market and to forecast potential trends with the introduction of AVs.

The study's theoretical framework incorporates several economic models to interpret these findings. Joseph Schumpeter's concept of Creative Destruction will be used to explore how innovation disrupts existing industries by replacing outdated systems. Metcalfe's Law, which posits that the value of a network grows proportionally to the square of its users, will help assess how AV adoption could enhance mobility networks. The Two-Sided Market Theory by Jean-Charles Rochet and Jean Tirole will provide insights into how platforms like Uber facilitate interactions between drivers and passengers, generating value through network effects. Additionally, William Baumol's Contestable Market Theory will be applied to understand how AVs could lower barriers to entry in the TLC market. To complement these models, the Lerner Index will measure market power and evaluate dynamics within this evolving landscape.

By combining these qualitative and quantitative methods with robust theoretical models, this research aims to deliver an understanding of how technological advancements like AVs are likely to transform the TLC market and urban mobility as a whole.

CHAPTER 2: Uber's Strategic Domination of the TLC Ecosystem

2.1 Medallion Rent-Seeking

Originating in 1937 to address an oversupply of taxi drivers, the medallion system capped the number of licenses, transforming an open market into one with strict barriers to entry (Etonomics, 2023). Medallions evolved into private property, creating an exclusive right to operate yellow cabs with street-hail privileges[1], establishing a "Medallion Exclusionary Zone"[2] (Wymant, 2013). This exclusivity limited the number of taxis regardless of demand, creating artificial scarcity.

Baumol's theory of contestable markets argues that market outcomes depend on the potential for new entrants, in which case even a monopoly can behave competitively if entry and exit remain free. Contestability requires low barriers to entry, minimal regulatory hurdles, and ideally an absence of initial costs (Baumol,1983). The NYC medallion system violated principles of Baumol's contestability theory by erecting insurmountable barriers to compete. The artificial restriction of taxi medallion supply created economic rent by inflating medallion values far beyond their connection to service quality. By 2014, medallions were selling for up to $1.3 million each (McEnery, 2020). A 1984 Federal Trade Commission analysis questioned the economic justification for such regulations, echoing Baumol's prediction that artificial barriers lead to inefficiencies.

[1] "Street hail privileges" are the legal rights granted to certain vehicles, like yellow taxis in New York City, to pick up passengers directly from the street when hailed.These privileges are regulated by the Taxi and Limousine Commission (TLC) and distinguish street-hail services from prearranged rides booked through apps or dispatch systems.

[2] The "Medallion Exclusionary Zone" refers to the Central Business District of Manhattan, where only medallion taxis are legally permitted to pick up passengers through street hails, excluding other vehicles like green taxis and For-Hire Vehicles (FHVs) from offering such services in this area

The medallion system fostered rent-seeking behavior, where individuals or firms gain wealth without contributing to societal value by leveraging economic or political power. In this case, the taxi industry used mechanisms to protect its monopoly, such as opposing Mayor Bloomberg's borough taxi initiative (Wymant, 2013). This was illustrated by, medallion owners successfully lobbied for a temporary cap on new rideshare licenses in 2018 to limit competition from platforms like Uber and Lyft (Columbia Law Review, 2020). However, the entry of ride-hailing platforms after 2011 disrupted this protected market, lowering barriers to entry and causing medallion values to collapse, validating that monopolies are vulnerable when competition is introduced (Rodriguez et al., 2020).

The collapse of medallion values triggered a financial crisis for many medallion owners (Rodriguez et al., 2020), exposing problematic lending practices (Rodriguez et al., 2020) and causing financial hardship for investors and drivers. This disruption highlights the risks faced by stakeholders when regulations fail to adapt to technological advancements.

2.2 Uber's Entry: Two-Sided Market Theory & Metcalfes

Traditional taxi markets - limited by artificial scarcity through medallion systems - were upended by Uber's platform model, which seamlessly connected riders and drivers in real time. Rochet and Tirole's (2003) two-sided market theory, along with Metcalfe's Law, provide useful frameworks for understanding Uber's growth and its disruptive impact on the taxi industry.

Uber's platform operates as a two-sided market, where value is created through cross-side network effects: the more drivers that join, the more attractive the platform becomes to riders,

and vice versa. Rochet and Tirole (2003) argue that successful platforms must strategically balance pricing and incentives to attract both sides of the market. Uber applied this by implementing surge pricing and driver incentives, optimizing engagement on both ends. As driver availability increased, wait times decreased, drawing in more riders. In turn, a growing rider base made the platform more lucrative for drivers. This self-reinforcing loop enabled Uber to scale rapidly, as the platform's value increased in line with user density on both sides.

Metcalfe's Law suggests that a network's value grows with the square of its user base - a law that helps explain Uber's exponential expansion. By 2017, Uber had grown New York City's for-hire vehicle supply from about 13,000 medallion taxis to over 80,000 ride-hailing vehicles, forming a feedback loop where higher driver density reduced wait times and fares, thereby sidelining traditional taxis (Marcus, M.,2019).

Uber's entry into the market dismantled the artificial scarcity created by medallion systems. In Chicago, similar patterns emerged: medallion prices plummeted from $360,000 in 2013 to $66,000 in 2016, accompanied by a 23% drop in taxi ridership (Bagchi, n.d). This decline reflects Uber's ability to disrupt established monopolies by democratizing access to ride-hailing services.

Through its dynamic pricing model, Uber undercut traditional taxi fares by 20–30%, using algorithms to respond to real-time demand. This also meant on peak days like New Year's Eve, surge pricing multipliers reached up to 9.9 times the base fare, efficiently balancing supply and demand - something fixed-rate taxi meters couldn't do (Springer, 2020). According to a National Bureau of Economic Research study, Uber created $1.60 in consumer surplus for every dollar spent, thanks to transparent pricing and lower search costs (Cohen, 2016).

Joseph Schumpeter's theory of Creative Destruction describes capitalism as a dynamic system in which innovation continually disrupts established industries, replacing outdated models with more efficient alternatives (Schumpeter,1942) . Uber's emergence in the urban transportation sector exemplifies this process, as it dismantled the traditional taxi medallion system that had long governed cities like New York. The medallion model, which limited market entry and inflated asset values, was supplanted by Uber's platform-based approach, enabling widespread participation through app-based ride-hailing. This shift lowered consumer costs and increased driver earnings, showing how technology shifted economic value .

Uber also exploited regulatory loopholes by classifying drivers as independent contractors, avoiding medallion costs and sidestepping labor laws. This allowed for rapid growth but created unfair competition, as taxis remained bound by strict insurance, licensing, and fare regulations, while Uber operated under more lenient "transportation network provider" standards (Springer, 2020).

Although Uber's network effects initially fostered competition, they eventually entrenched the company's market dominance. Cross-side dependencies and switching costs - such as inefficiencies from drivers using multiple apps - erected entry barriers for rivals like Lyft.

2.3 The Lerner Index: Foundations and Applications

The Lerner Index, introduced by Abba Lerner in 1934, is a fundamental tool in economics for quantifying market power - the ability of a firm to raise prices above marginal costs without losing customers. It is calculated as:

$$\mathbf{L = (P - MC) / (P)}$$

where *P* represents the price charged by the firm and *MC* is its marginal cost. The index ranges from 0 to 1, with $L = 0$ indicating perfect competition (where $P = MC$) and values closer to 1 signifying greater market power, such as in monopolistic settings (Lerner, 1934). Factors influencing the index include - but are not limited to - price elasticity of demand, competition intensity, and regulatory constraints.

Using the original Lerner index, we can construct examples to illustrate the market power of traditional yellow cab taxis, Uber, and autonomous vehicles (AVs), to compare results. These examples are hypothetical and serve only as demonstrations.

In regulated taxi systems, pricing flexibility is limited due to government oversight. Assuming a taxi fare of $20 and marginal costs (driver pay, gas, maintenance) of $16, the Lerner Index for taxis would be:

$$\mathbf{L}\ \boldsymbol{Taxi} \mathbf{= (20 - 16) / (20)}$$

$$\mathbf{L}\ \boldsymbol{Taxi = 0.20}$$

A Lerner index of 0.2 signifies that the firm possesses some market power, though it is far from a monopolist. Specifically, this indicates that the firm's price is 20% higher than its marginal cost, suggesting it can set prices above marginal costs due to factors such as limited competition or inelastic demand. However, the firm's market power is relatively modest when compared to

firms with higher Lerner index values nearing 1. This lower value reflects constrained market power, likely influenced by regulatory forces, such as fixed pricing structures imposed by entities like the TLC (Omnicalculator, 2024).

Uber on the other hand operates as an intermediary platform rather than a direct service provider. Its cost structure includes driver payments (D) and incremental platform costs (I), with revenues derived from commissions or "take rates." The adapted formula for platform businesses becomes:

$$L = P - (D + I) / (P)$$

For this hypothetical example, Uber's incremental platform (I) costs are considered negligible because the expenses related to maintaining its app and infrastructure are fixed and spread across many rides, meaning they don't increase significantly with each additional ride. The primary variable cost is the payment to drivers, which far outweighs the platform's operational costs:

Now for Uber, let's say they are able to do the same trip but for $25 due to price surging, with $15 paid to drivers and $14 as marginal costs. The Lerner Index is calculated as:

$$\mathbf{L}\ \mathit{Uber} = (25 - 14) / (25)$$

$$\mathbf{L}\ \mathit{Uber} = 0.44$$

The Lerner Index of 0.44 means that Uber is able to charge a price that is 44% higher than its marginal cost. This reflects Uber's significant market power, as it can set prices above costs due

to its role as an intermediary platform with relatively low incremental costs, allowing it to retain a larger portion of the fare (compared to traditional taxis). (Eng, 2024; Omnicalculator, 2024).

Impact of Autonomous Vehicles (AVs)

Lastly, the autonomous vehicles (AVs) which could further reduce marginal costs for Uber. For instance, if the marginal cost per trip drops to $6 while fares remain at $25, the Lerner Index becomes:

$$\mathbf{L}\ \boldsymbol{Uber\ with\ AVs} = (25 - 6) / (25)$$

$$\mathbf{L}\ \boldsymbol{Uber\ with\ AVs} = 0.76$$

The Lerner Index of 0.76 means that, with autonomous vehicles (AVs) reducing Uber's marginal cost to $6, Uber can charge a price that is 76% higher than its marginal cost. This indicates that Uber's market power increases significantly because it can set prices much higher relative to its costs, demonstrating a greater ability to generate profit due to the reduced operational costs associated with AVs.

The analysis of the Lerner Index across traditional yellow cab taxis, Uber, and autonomous vehicles (AVs) illustrates how market power varies within different business models and technological advancements. Traditional taxis, with a Lerner Index of 0.20, have limited market power due to regulatory constraints and competition, preventing them from setting significantly higher prices. In contrast, Uber, as an intermediary platform, has a greater Lerner Index of 0.44, reflecting its ability to charge higher prices thanks to relatively low incremental costs per ride. Uber's model allows it to retain a larger portion of the fare, enhancing its market power. The introduction of autonomous vehicles further amplifies Uber's market power, with the Lerner

Index rising to 0.76 due to a dramatic reduction in marginal costs. This increase suggests that Uber could charge much higher prices relative to its costs, allowing it to capture even more profit. Overall, the Lerner Index highlights how technological advances, such as AVs, can significantly shift market dynamics, increasing a firm's ability to set prices and dominate the market, signaling a move towards monopolistic behavior.

CHAPTER 3: Interviews & Economic Models

This section presents findings derived from interviews with three key stakeholders.

The first stakeholder, an Uber driver, represents the gig economy model. This model is defined by short-term, flexible labor arrangements that are mediated through digital platforms, where workers are categorized as independent contractors. The second stakeholder, a traditional taxi driver, illustrates the regulated monopoly model historically governing the taxi industry. Under this model, government regulation through the issuance of medallions restricted market entry, creating artificial scarcity and generating monopoly rents. The third stakeholder, a garage owner, provides insight into the adaptive business model. This strategy allows firms to adjust to external shocks by reconfiguring their resources.

The interviews with these stakeholders offer valuable perspectives on the economic and social consequences of Uber's rise, while also shedding light on the challenges and opportunities that could arise from the potential integration of autonomous vehicles (AVs) within the transportation sector.

3.1 Uber Driver: Transitioning from Yellow Cab to Ride-Hailing

The interview with the Uber driver provides valuable insights into the shifting dynamics from traditional taxi services to ridesharing platforms like Uber. This change reflects broader trends in urban transportation, labor economics, and technological disruption, particularly in industries previously dominated by monopolistic systems.

The driver highlighted the financial challenges faced by traditional taxi drivers, noting, "*When I started driving yellow cabs in 2000, it was good. I support my family, pay bills, and save money.*

But 2018, it was struggle. The medallion value finish and the streets full of Uber." This statement underscores the significant impact of ridesharing platforms on the taxi industry, particularly in terms of financial viability. The collapse of medallion values, once a cornerstone of the taxi business, symbolizes the disruption of monopolistic systems by platforms like Uber. Taxi medallions, once considered valuable assets, lost substantial value due to the competition introduced by ridesharing services.

For many drivers, the switch to Uber initially offered financial relief and flexibility. The driver mentioned that with Uber, *"The money was better. No daily lease and I choose my hours. If I wanted to take a day off, I could."* This flexibility, a core advantage of Uber's gig economy model, allows drivers to set their schedules and avoid the rigid shifts imposed by traditional taxi services. However, this flexibility came at a cost, as the driver later expressed concerns over diminishing earnings: *"Uber keeps taking a bigger cut. Now, I'm working hard like yellow cab, but the earnings are unpredictable."* The shift to Uber, while initially promising, has not insulated drivers from the volatility and unpredictability of earnings, as the dynamic pricing model and rising commission rates continue to affect their financial stability.

Ultimately, the interview sheds light on several critical tensions within the gig economy. Ridesharing platforms like Uber have revolutionized urban transportation, but this innovation has come at the expense of traditional industries, such as taxis, destabilizing long-established economic systems. While Uber offers drivers flexibility, many face precarious work conditions, with earnings that are unpredictable and without the benefits and security that come with traditional employment. Additionally, the looming prospect of automation, particularly in the form of autonomous vehicles, presents further challenges for workers who rely on human-driven services.

3.2 Traditional Taxi Drivers: Struggling to Compete

The traditional taxi industry, particularly those operating under medallion-based systems like New York City's yellow cabs, has faced significant challenges with the advent of app-based ride-hailing services such as Uber and Lyft. These companies disrupted an established market and forced many taxi drivers to confront both economic and technological shifts that have altered their livelihoods.

One yellow cab driver reflected on the collapse of the medallion system, explaining that when he purchased his medallion in 2008 for over $600,000, he viewed it as a long-term investment, something that would secure his future. At the time, it seemed like a good decision, but with the rise of ride-hailing services, the value of medallions has plummeted to less than $100,000, leaving many drivers stuck with unsustainable debts.

The introduction of Uber and Lyft, which operate without the same regulations as traditional taxis, further compounded the problem. The yellow cab driver lamented that Uber *"destroyed everything,"* noting that passengers no longer had to wait for a yellow cab when an Uber could arrive in just a few minutes. The ability of ride-hailing services to streamline their operations using app-based bookings and GPS tracking gave them a clear edge in convenience, and traditional taxis struggled to keep pace with this technological shift.

Frustration with regulatory agencies such as the New York City Taxi and Limousine Commission (TLC) was also prevalent. The yellow cab driver put it, the TLC *"didn't do enough to protect us,"* failing to act swiftly enough to mitigate the impact of Uber and Lyft's rise. Although regulations were later enacted to cap the number of rideshare vehicles in the city, these measures arrived too late to prevent widespread financial hardship among traditional taxi drivers.

Moreover, the looming prospect of autonomous vehicles has added another layer of uncertainty to the industry. The yellow cab driver expressed skepticism about self-driving cars, questioning their feasibility in chaotic urban environments like New York City. The rapid advancements in autonomous vehicle technology, backed by companies like Uber, present potential disruptions for traditional drivers who face an unclear future.

At this crossroad, the traditional taxi industry faces immense challenges from a combination of financial pressure, competitive disadvantages, and technological shifts. To survive, the industry will need to embrace innovation, advocate for fair regulatory reforms, and find ways to adapt to the changing landscape while protecting the livelihoods of its workers.

3.3 Taxi Garage Owner: Adapting to Change

The experience of a taxi garage owner in Queens, New York, who has been in the business for over two decades, provides a different perspective on the changing dynamics of the industry. The garage owner saw firsthand the impact of ride-sharing platforms like Uber, describing their arrival as a *"complete disaster"* for the taxi business. The immediate effect was widespread medallion defaults and a sharp decline in business. This mirrors the broader industry trends where established businesses struggled to compete with the efficiency and technological edge of new entrants.

However, the garage owner's ability to diversify his business highlights a strategy for resilience in the face of disruption. By beginning to service ride-sharing vehicles, the garage owner adapted to the evolving market rather than resisting the changes. This shift demonstrates how traditional businesses can capitalize on new opportunities created by technological advancements, even if those advancements initially appear threatening.

Looking forward, the garage owner expressed cautious optimism about the potential of autonomous vehicles (AVs). He described AVs as a potential "game-changer" for the industry, predicting they could reduce accidents, lower maintenance costs, and eliminate the need for human drivers. His perspective aligns with growing research that suggests AVs could revolutionize transportation by increasing safety through advanced sensors and cameras while significantly cutting labor costs.

In summary, the taxi garage owner’s story showcases how businesses can adjust to disruptive forces by being flexible and forward-thinking. The success of this adaptability can be seen in how the garage owner leveraged the rise of ride-sharing services to keep his business afloat and remained open to the possibilities of autonomous vehicles, despite the uncertainties involved.

Chapter 4: Autonomous Vehicles and the Taxi Market Transformation

4.1 AVS & Porter 5 Forces Analysis

Strategic Intent and Historical Evolution

Uber's strategy for autonomous vehicles (AVs) plays a crucial role in shaping its long-term position within the transportation sector. The company's pursuit of AV technology began in 2015 with the establishment of the Advanced Technologies Group (ATG), which was designed to reduce Uber's reliance on human drivers (Cbinsights, 2024). While the exact figure remains uncertain, it's clear that Uber would see significantly higher profits if it were no longer required to compensate drivers. The goal was to transition towards self-driving vehicles, which could potentially lower costs and improve efficiency.

However, Uber encountered major challenges along the way. One of the most notable setbacks occurred in 2018, when one of its autonomous vehicles was involved in a fatal accident in Tempe, Arizona, which raised serious ethical and safety concerns (Times, 2018). Despite these difficulties, Uber continued its pursuit of AV technology until 2020, when it decided to sell ATG to Aurora Innovation for $4 billion. This decision marked a significant shift in Uber's strategy, moving away from developing autonomous vehicles internally and instead opting for a partnership with Aurora to advance its AV ambitions.

To better understand Uber's strategic evolution in the context of autonomous vehicles, it's important to analyze the forces shaping the industry and its competitive environment. As we transition from Uber's history of AV development to the competitive landscape, Porter's Five

Forces analysis provides a framework to assess the challenges and opportunities Uber faces in its pursuit of autonomous vehicle technology.

Porter's Five Forces Analysis

- *Threat of New Entrants:* High capital requirements for AV technology deter new entrants. Established players like Waymo and Cruise benefit from regulatory familiarity, giving Uber an advantage through existing TLC relationships.
- *Bargaining Power of Suppliers:* Partnerships with Aurora, Waymo, and Cruise create mutual dependencies. While Uber's large user base provides leverage, limited AV technology providers constrain its options.
- *Bargaining Power of Buyers:* NYC consumers have diverse transportation options. However, Uber's network effects, brand recognition, and integration of Uber One membership reduce buyer power through increased switching costs.
- *Threat of Substitutes:* Public transit remains a strong alternative in NYC. Yet AVs promise convenience, reliability, and potential cost advantages that could compete effectively with traditional modes.
- *Competitive Rivalry:* Competition is intense among ride-hailing services like Lyft (partnered with Motional) and technology firms like Tesla. AV deployment intensifies this rivalry as companies race for cost advantages.

Uber's journey toward autonomous vehicles reflects both its ambition to reduce costs and enhance efficiency, as well as the complex challenges and strategic shifts it has faced. Porter's Five Forces analysis highlights the intense competition, high capital barriers, and dynamic

supplier relationships that shape Uber's path forward. Despite these challenges, Uber's extensive network, strong brand recognition, and innovative partnerships position it to continue playing a pivotal role in the transformation of the taxi market.

4.2 AVs Disruptive Innovation and Market Evolution (Analogous Disruptions)

Clayton Christensen's theory of disruptive innovation, in *The Innovator's Dilemma* (1997), describes how simpler, more affordable innovations can upend established industries by initially targeting overlooked or underserved market segments before improving to compete with mainstream offerings (Christensen, 1997). Applying this framework to the rise of AVs in NYC reveals their potential to disrupt the traditional taxi industry.

Disruptive innovation is not merely a superior product or service; it is a process that begins with technologies or business models targeting low-end or entirely new markets. These innovations often underperform on traditional metrics valued by incumbents but excel in alternative dimensions, such as affordability, convenience, or scalability. Over time, they improve and invade mainstream markets, challenging established players who are often constrained by their existing value networks and business priorities (Christensen, 1997; Schmidt & Druehl, 2008).

To begin in regards to performance trajectory traditional taxis and ride-hailing services like Uber have followed a sustaining innovation trajectory, focusing on incremental improvements to the human-driver model, such as better route optimization or customer service. In contrast, AVs represent a fundamentally different performance trajectory. Initially, AVs may underperform in

complex urban environments like NYC due to challenges in navigating irregular traffic patterns or handling unpredictable road conditions. However, they excel in other dimensions such as consistency, availability, and cost-efficiency (Schmidt & Druehl, 2008). Over time, as AV technology matures and addresses its initial shortcomings, it is likely to become competitive with traditional human-driven services.

Following the pattern of low-end disruption described by Christensen (1997), AVs are expected to first target niche markets where their limitations are less impactful. For instance, they may initially serve cost-sensitive customers in specialized contexts such as airport transfers or business districts. These markets demand basic transportation services where attributes like affordability and reliability outweigh the need for nuanced driving skills. As AV technology improves, it will likely expand into broader market segments, eventually competing directly with traditional taxis and ride-hailing services across NYC.

Traditional taxi operators face a classic innovator's dilemma: their existing business models and investments in medallions—valued between $80,000 and $120,000 as of 2025—create significant financial disincentives for embracing disruptive AV technologies (Schmidt & Druehl, 2008). Similarly, Uber faces challenges in transitioning from its current driver-dependent model to an autonomous fleet due to potential disruptions to its labor force and customer relationships. These constraints mirror historical cases where incumbents failed to adapt to disruptive innovations because they prioritized short-term profitability over long-term strategic shifts.

Autonomous vehicles exemplify disruptive innovation as conceptualized by Clayton Christensen. By targeting niche markets before expanding into mainstream applications, AVs have the potential to fundamentally alter the competitive landscape of NYC's taxi industry.

Analogous historical disruptions in various transportation sectors provide valuable insights into the competitive dynamics and adaptation challenges facing industries during periods of significant technological change. By examining these parallels, we can better understand the trajectory of the taxi industry amidst the rise of autonomous vehicles (AVs) and other innovations.

The disruption of traditional film photography by digital technology offers a compelling analogy to the current challenges faced by the taxi industry. Kodak, despite being a pioneer in digital photography, failed to capitalize on its own invention due to organizational rigidity and an unwillingness to cannibalize its profitable film business (Tripsas & Gavetti, 2000). This reluctance mirrors the struggles of traditional taxi operators, who possess deep market knowledge and strong customer relationships but often lack the agility to adapt to disruptive innovations like ride-sharing platforms or AVs. Research highlights how cognitive biases and entrenched organizational structures can prevent incumbents from responding effectively to visible technological threats (Gavetti, 2000).

Another relevant parallel emerges from the telecommunications sector's transformation from circuit-switched to packet-switched technologies. Geels' (2002) framework on technological transitions illustrates how industries undergo "regime shifts," where dominant systems face

mounting pressure from niche innovations with superior economic characteristics. The taxi industry appears to be at a similar juncture, where traditional systems are being challenged by AV technologies that promise greater efficiency and lower costs. This phase often involves a gradual erosion of incumbent dominance as new entrants gain traction, reshaping competitive landscapes.

The restructuring of the airline industry following deregulation provides further insights into how regulatory changes interact with technological innovation to reshape markets. Studies reveal that deregulation led to increased industry concentration, with a few large players dominating while smaller operators focused on specialized niches (Borenstein & Rose, 2014). This pattern may foreshadow the future evolution of the NYC taxi market, where large AV fleet operators could dominate, leaving traditional taxis to serve niche segments such as luxury or specialized services. Regulatory frameworks will likely play a pivotal role in determining how these dynamics unfold, influencing market entry barriers and competitive strategies.

By understanding lessons from these analogous disruptions, we can analyze recurring patterns: incumbents often struggle with adaptation due to organizational inertia, niche innovations gradually gain dominance through superior economic attributes, and regulatory changes can accelerate market restructuring. These insights emphasize the critical need for strategic agility and proactive engagement with emerging technologies in order to thrive amidst disruption.

CHAPTER 5: Conclusion

5.1 Summary of Findings

Uber's rise to dominance in the transportation sector exemplifies a profound disruption of traditional markets, primarily the tightly controlled medallion-based taxi system. Introduced in 1937, the medallion system was designed to limit the number of taxi licenses, creating an exclusive market for yellow cabs. This artificial scarcity inflated medallion values to $1.3 million by 2014 and fostered rent-seeking behavior, as industry stakeholders lobbied to protect their monopoly. However, this exclusivity violated economic principles like Baumol's theory of contestable markets, which advocates for low barriers to entry. The arrival of ride-hailing platforms such as Uber and Lyft after 2011 upended this system, causing medallion values to plummet and leaving many medallion owners in financial ruin.

Uber's innovative platform connected riders and drivers in real-time, leveraging two-sided market dynamics as described by Rochet and Tirole's theory. The platform's value grew with increased participation from both drivers and riders, a phenomenon further amplified by Metcalfe's Law. Uber's surge pricing and driver incentives balanced supply and demand, enabling rapid scaling. By 2017, Uber had expanded New York City's for-hire vehicle fleet from 13,000 medallion taxis to over 80,000 ride-hailing vehicles. Its dynamic pricing model undercut traditional taxi fares, generating significant consumer surplus—estimated at $1.60 for every dollar spent according to a National Bureau of Economic Research study.

This transformation aligns with Joseph Schumpeter's concept of Creative Destruction, where innovation displaces outdated systems. Uber exploited regulatory loopholes by classifying

drivers as independent contractors, bypassing medallion costs and labor laws. While its network effects initially spurred competition, they eventually entrenched Uber's dominance through cross-side dependencies and high switching costs. The company's growing market power can be quantified using the Lerner Index, which measures the ability to set prices above marginal costs. For traditional taxis with fares of $20 and marginal costs of $16, the Lerner Index is 0.20, reflecting limited pricing power due to regulation. In contrast, Uber's fare structure—with a $25 charge and $14 marginal costs—yields a Lerner Index of 0.44. Autonomous vehicles (AVs) further shift this dynamic; with marginal costs reduced to $6 while fares remain at $25, the Lerner Index jumps to 0.76, signaling heightened monopolistic tendencies.

Interviews with stakeholders reveal the human impact of these disruptions. An Uber driver who transitioned from yellow cabs initially found financial relief but now faces precarious earnings due to rising commission rates. A traditional taxi driver lamented unsustainable debts caused by collapsing medallion values and criticized regulators for failing to protect their industry. Meanwhile, a taxi garage owner adapted by servicing ride-hailing vehicles and expressed cautious optimism about AVs as potential industry game-changers.

The integration of AVs into ride-hailing platforms represents another wave of disruption. Applying Porter's Five Forces framework reveals that while AV technology lowers barriers for new entrants, Uber benefits from established relationships and scale advantages. Buyers retain bargaining power due to diverse transportation options; however, Uber's network reduces this leverage through loyalty programs. Public transit remains a strong substitute, but AVs promise

greater convenience and cost advantages. Competitive rivalry intensifies as tech firms race to achieve cost efficiencies through AVs.

In regards to Clayton Christensen's theory of disruptive innovation: AVs initially target overlooked market segments before scaling to challenge dominant players. Historical parallels include Kodak's failure to adapt to digital photography and the airline industry's consolidation post-deregulation.

5.2 Implications for the Taxi and Limousine Commission (TLC)

The medallion collapse forces TLC to rethink its licensing framework and address the human costs, such as the crippling debts faced by thousands of medallion owners.

The economic and market dynamics have also shifted dramatically. Uber's model has created precarious earnings for drivers, exacerbating economic instability within the industry. Moreover, Uber's dominance reflects higher pricing power compared to traditional taxis, as evidenced by its Lerner Index, indicating monopolistic tendencies that may necessitate antitrust scrutiny (designed to promote fair competition and prevent monopolistic practices) or fare regulations. As the industry evolves further with the integration of autonomous vehicles (AVs), TLC must prepare for regulatory frameworks addressing AV safety, labor displacement, and equitable access. This includes developing adaptive policies that balance innovation with public interest and ensuring fair market conditions amidst intensifying competition among tech firms. By evolving from a regulator of a closed medallion system to an adaptive policymaker, TLC can navigate this dynamic transportation landscape effectively.

5.4 Concluding Remarks

Uber's disruption of the transportation sector exemplifies creative destruction, upending the medallion-based taxi system through technological innovation and strategic exploitation of regulatory loopholes. While Uber's platform initially benefited consumers and drivers, its growing market power, amplified by network effects and the potential integration of autonomous vehicles, raises concerns about monopolistic tendencies. Stakeholder interviews highlight the human impact of these changes, with traditional taxi drivers facing financial ruin and Uber drivers experiencing precarious earnings. As autonomous vehicles reshape the industry landscape, policymakers must address potential market imbalances to ensure fair competition and protect the interests of all stakeholders.

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About The Author

I’m writing this on Sunday, April 7, 2025, just moments before submitting this dissertation paper.

When I came to Allegheny, my sole purpose was to earn a degree. I arrived uncertain - unsure of what I wanted to study and, more profoundly, unsure of who I was.

After four years, I cannot claim to have “found myself.” But I’ve come to realize that perhaps no one ever truly does. Life is not about discovering a fixed identity but about evolving through experiences. Over these years, I’ve formed countless friendships, connections, and memories that have shaped me into the person I am today. Who I am is not entirely within my control; I am a product of the moments and interactions that have defined my journey.

And yet, there’s beauty in this realization. To anyone reading this: make memories. They are worth more than anything else. The diploma I’ll receive when I walk across the stage in a few days, while significant, pales in comparison to the experiences I had here. What once seemed like the ultimate goal - the degree - is now just a symbol of a much larger journey.

Your current situation sets the stage for your future. Ensure you're in the best position possible today to become the person you want to be tomorrow.

But, remember to live. Don’t waste your time in situations that don’t align with your dreams, but also don’t forget to savor life along the way.

That dream? Chase it. That opportunity? Seize it. That moment of solitude? Use it to reflect and grow.

A night out with friends will hold more value than any assignment or test ever could. Work will always be there; life won’t.

Take a moment to appreciate these blessings. Smile, and truly live. Cherish each day, for it is a gift. In a world filled with challenges, find joy in the simple things and make the most of every moment.

Make memories - because in the end, they’re what truly matter.

A Message to Sarah:

I want you to absorb a truth that will carry you forward: everything is possible.

The only limits you face are the ones your mind constructs or those imposed by a world too often steeped in negativity and self doubt. Your soul belongs to you. Guard it, for it is the compass that will guide you through life's trials and triumphs.

But remember, no matter how high you climb or how far you journey, your success is never yours alone. It is woven from the sacrifices, love, and wisdom of those who walked beside you and believed in your potential when you doubted it yourself. However, there will come a day when the voices of guidance that once surrounded you grow quieter, fading into the background like whispers on the wind. On that day, Sarah, your true journey begins - not with their steps but with your own.

Mistakes will come; they are inevitable and necessary. But do not let them define you. You are not merely a girl navigating life's currents - you are Sarah. A name imbued with strength, a legacy to uphold, and a purpose waiting to be fulfilled. Wear that name proudly and let it remind you of the greatness that lies within.

Strive for excellence, as your mother did before you. Not because perfection is expected but because the pursuit of greatness shapes who we become.

You are the last cousin and cherished niece of this family - the closing chapter of our story. Finish strong. Strive to be extraordinary in all that you do.

Now, Sarah, this is your time. Embrace it with courage and grace

We all Love you.

RAJA HAARIS AJAZ