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The Economic Impact of Transportation Network Companies on the Taxi Industry

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THE ECONOMIC IMPACT OF TRANSPORTATION NETWORK COMPANIES ON THE TAXI INDUSTRY

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Abstract

Transportation Network Companies (TNC) are companies that use online-enabled platforms to connect passengers with drivers. In recent years, they have sparked controversy with the taxi industry, which accuses TNCs of operating unfairly. In my study, I look at taxi regulation, consumer transportation preferences, and costs and benefits of TNCs. I analyze data comparing three of these companies, Uber, Lyft, and Sidecar, with a traditional taxicab, and evaluate trends in taxi employment from the Bureau of Labor Statistics. I find that Transportation Network Companies generally have shorter wait times, cheaper prices, and increased convenience, aspects that appeal to consumer preferences. I also find that taxi driver employment tends to fluctuate with economic conditions, however cities that are more likely to use TNCs exhibit smaller growth. I predict that at current conditions, TNCs such as Uber and Lyft will overtake taxi services. Thus, the taxi industry must focus on increasing TNC regulation, creating innovative technology, and modifying its service to appeal to consumers.

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Introduction

In the city, nightlife takes on a different meaning. Dinner turns into drinks, drinks turn into the club, and the club turns into wherever the night ends. Instead of spending an arm and a leg on metered city parking or calling an overpriced taxicab, in recent years partygoers have been known to catch a ride with Uber, Lyft, or Sidecar. Launched in San Francisco, this new transportation service appeals not only to partygoers, but also a wide range of other groups including families, businessmen, and travelers. Uber, Lyft, and Sidecar are three of the most successful start-up companies to date and are available in over 100 cities worldwide.

An innovative blend of technology, transportation, and low-cost convenience, Transportation Network Companies (TNC) appeal to the interests of all people with a smartphone. TNCs utilize three major technologies: GPS navigation, smartphones, and social networks, each serving a distinct purpose. GPS navigation systems provide ride efficiency in both distance and time, smartphones allow for convenience and accessibility, and social networks build trust and accountability for both the drivers and the riders. These companies operate similar to a taxi service, however they differentiate in that TNCs use online-enabled platforms to connect riders to drivers using their own personal vehicle. Providing a service called 'real-time ridesharing,' the user-friendly apps operate with only one click, locating not only the location of the potential rider, but also the density of drivers nearby and the wait time for the closest driver. They also provide driver information and a method of contact in order to arrange the one-time shared rides. The payment system is simple—price is calculated with respect to speed and distance, and customers are billed directly, with receipts sent via email. Convenient and fast, these apps remove stress from both the driver and the rider, providing strong incentives for riders to switch from taxi service to ridesharing.

However, accompanying all their success, TNCs confront controversy and outrage from employees of the taxi industry. Even though companies such as Uber promote ridesharing as a way to fill up empty seats in passenger cars, they function similarly to a taxi service, and are therefore seen as a threat to traditional taxicab drivers competing for the same consumer base. Perhaps the biggest complaint the taxi industry has is that TNCs operate without proper regulations, avoiding the licensing costs, driver insurance, standard employee training, and routine background checks that taxi drivers are subjected to. Taxi drivers argue that since TNCs and taxis serve an almost identical purpose, they should have the same restrictions and costs. While some states show an overall increase in taxi industry employment, others show a decrease, making the effect of ridesharing ambiguous.

Through employment data, as well as prices, availability, and flexibility of ridesharing apps and taxi services, I evaluate how ridesharing apps impact the taxi industry. I use data from Uber, Lyft, and Sidecar mobile apps, as well as whatsthefare.com to collect data on estimated prices and time of arrival. By comparing the prices, I predict the impact TNCs will have on the taxi industry based on consumer preferences. This data will consider an expanded area in each selected city based on six different times the day. By analyzing data that spans different states and certain major metropolitan areas in which TNCs are popular, I evaluate the overall trend of paid taxi industry employees, and consider the potential variables that could contribute to the trend. Data from the Bureau of Labor Statistics will provide information on the trends of the taxi industry. This will allow me to conclude whether Transportation Network Companies are sustainable competitors, serving as assets in transportation efficiency for both the consumer and the affected industries, or if they act as price and quality substitutes for the taxicab services and thus lead to the potential elimination of the taxi industry.

Literature Review

While some literature has attempted to hypothesize the impacts of Transportation Network Companies on the taxi industry, analytical data on the short and long-term impacts are yet to be determined. Of the companies that provide mobile app-based, on-demand ride services, Uber and Lyft are believed to hold approximately 80% of the market share (Rayle 2014). Founded in 2009 and 2012 respectively, the two private companies have released very little data, resulting in a lack of knowledge on revenues, ride statistics of frequency, distance, and time, and potential impacts in cities with higher densities of TNCs. In this section, I summarize the most relevant literature impacting my hypothesis that ridesharing apps will have a detrimental effect on the taxi industry in the long run. I explore logistics of the taxi industry, investigate changes in consumer preference of ownership and convenience, and compare the developing mobile ridesharing industry with other industries in the sharing economy.

Even without the complications of ride-sharing competitors, the taxi industry exhibits unique analytical problems. Used most commonly by businessmen and travelers, taxis are subject to the precarious nature of supply and demand, emphasized especially during peak times. Each individual ride impacts the wait time of other potential rides, thereby creating high opportunity costs (Cairns 1996). As a result, taxis achieve optimal prices and number of taxis through a regulation of price that factors in both fixed cost and waiting-time compensation (Cairns 1996). In some cities, such as New York, there is a limit on taxicab licenses in order to reduce unsafe competitive behavior and maintain prices for drivers. With the formation of this precarious balance, the market for ride services essentially becomes an open-access resource that is subject to over-entry, meaning that taxi companies only hire a certain number of drivers or otherwise face profit loss.

Similar in method of transportation, Transportation Network Companies services follow a point-to-point route of travel; therefore these services are often perceived as entrants in the taxi market. However, findings show there are contesting opinions on the debate between taxicabs and TNC services. Supporters of the latter service claim that Transportation Network Companies such as Uber and Lyft fulfill a previously unmet demand of quick and convenient mobility, as TNC services require as little effort as the tap of a button (Rayle 2014). This opinion suggests the consumer base of TNCs is not identical to that of traditional taxicabs. Instead, people entered this transportation market specifically due to the unique and convenient ridesharing of app-based mobility. This perspective is supported by the Bureau of Labor Statistics, which lists the job outlook for taxi drivers and chauffeurs at a positive 16%, which is considered faster than average by BLS standards (BLS). This statistic, which measures self-reported taxi drivers and chauffeurs, may include TNC employees, however, the BLS credits the job outlook to an increase in paratransit services. In opposition, critics claim that companies such as Uber and Lyft serve identical roles as taxi drivers, but without proper regulations that are used to counteract negative externalities such as job misconduct in taxi services (Rayle 2014). As TNCs and taxicab companies operate differently, it is unsure whether these taxi regulations should apply directly. Through a variety of platforms, social media provides TNC consumers with the information needed to reduce negative externalities, and with online profiles, drivers are held accountable for their actions on the job.

The University of California Transportation Center addressed these theories through intercept surveys of ridesharing customers in the San Francisco area. The methodology used by UCTC targeted two types of respondents: those who just completed a trip, and those who had completed a trip within the last two weeks, prioritizing the former. The results of their survey

answered a series of questions relating to consumers of transportation network companies. Predominantly young and educated, the respondents ranged from 15-54 years of age, with varying annual income levels and often tech-savvy individuals, creating a sample that is likely to be biased (Rayle 2014). Of the 380 completed responses, a 77% majority reached destinations within the San Francisco area, with an additional 8% elsewhere in the Bay Area. Wait times were dramatically shorter for riders of app-based ridesharing than riders of a typical taxi ride, and overall, this form of transportation was well perceived. Most significantly, when asked what method of transportation would be used otherwise, 39% answered taxi (Rayle 2014). Other responses included forms of public transportation as well as driving, however taxi was the most popular response. This percentage signifies a large number of potential customers, and although the services are not perfect substitutes, there is evidence of substitutability. Through collection of data, the UCTC concluded that both services cater to a similar market demand, but TNCs meet a latent demand for urban travel, and appeal to a younger generation of riders. The results of UCTC's survey introduces the possibility of a new demand of riders who utilize apps such as Uber and Lyft because of the reliability, comfort, and convenience of this new form of mobility that taxis have yet to adapt. Consequently, it suggests that TNCs create a unique population demand that is separate from the market formerly reserved for taxi services.

While ridesharing may have a negative impact on the taxi industry, this form of transportation has a potential positive impact on traffic in populated metropolitan areas. In assessing the impacts of ridesharing, it is important to consider also the indirect effects that may result. In cities such as New York and Los Angeles, travel by car is a popular method of transportation, resulting in high densities of traffic throughout the city center and surrounding areas. A recent study completed at UbiComp by students of the University of California, Irvine

and Telefonica Research analyzed data sets from call description records and online social networks to assess the potential for reducing traffic. Factors considered included transportation patterns, departure and destination locations, and social connections between customers (Cici 2014). In essence, the study assessed citywide benefit though a decrease in traffic. Due to the lack of data available from app-based ridesharing companies, the work is based partly on publicly available data through Twitter and Foursquare. The study methodology used inferences of home/work distances, departure times, social constraints, and concluded that there is a significant overlap in the routes taken by people from home to work (Cici 2014). This suggests a significant benefit to reduced traffic and costs for both the consumer and provider. This increase in efficiency is relevant because the higher the population of people who own cars, the lower the possibility of taxi-use.

As a result, the system of TNC ridesharing may also positively impact of the taxi industry by increasing consumer base and reducing costs caused by traffic. While ridesharing systems would benefit highly, indirectly taxicabs may acquire higher volumes of riders and therefore also increase profitability due to a trend of decreased car ownership. This trend would increase the consumer base, thereby increasing usage of TNCs and taxi services. To increase efficiency even more, the UbiComp paper considers en-route ridesharing, in which drivers pick up additional passengers who add negligible extra costs to pick-up and drop off (Cici 2014). Findings show that the decrease in number of cars in a given city can be as high as 31% when people are willing to rideshare with friends of friends. For UberPool and LyftLine, which are versions of Uber and Lyft that promote shared rides along shared routes, strangers ride together and risk a more time-consuming commute, but also split ride fare. These transportation services face difficulties regarding transportation laws, which prohibit separate payments of a truly ridesharing service.

This regulation places an important barrier for Transportation Network Companies, because the introduction of en-route ridesharing would surely drive out the taxi industry. Thus, it helps to maintain a balance between the sustainability of both TNC and taxi industries.

The concept of ridesharing seems simple and effective, however Transportation Network Companies combat aggressive resistance from competing industries. This barrier to entry is common for industries in the sharing economy. Systems of other sharing economy industries, which include transportation, hospitality, and consumer services, provide a model for which companies such as Uber and Lyft can expect to follow in terms of the future of established industries and success through resistant conflict. To define the "sharing economy," Samuel Nadler explains an economy based on human and physical assets, which is dependent upon a currency of trust (Nadler 2014). Well-known sharing economies include Airbnb, in which people share homes for a nightly fee, Zipcar, shared cars with an hourly or daily fee, and Taskrabbit, shared services in a given community. He credits the popularity of this new economy of sharing to convenience, accessibility, and recent economic conditions that encourage people to minimize the burden of ownership, whether that may be a home, a car, or other goods (Nadler 2014).

However, this new economy is disruptive in nature, which is why it faces backlash from established competitors, searching for laws and regulations to back their claims. In the example of Airbnb, a platform that connects travelers to property owners looking to rent out extra rooms, the company maintained lower accommodation prices, technologically convenient appeal, and unparalleled personal connections. Its international success threatened the hotel industry, who argued that Airbnb spaces did not require the same standard of maintenance and regulation, an argument similar to that which TNCs are currently facing (Nadler 2014). Contrasting from hotels, Airbnbs create a niche market of renters who appreciate the genuine community

engagement component of being a guest in another's home (Nadler 2014). Partially due to its distinctiveness and community efforts, and partially due to lesser resistance by the hotel industry, the room-renting company has become a successful sharing economy. In a 2013 study, it was estimated that for every 1% increase in Airbnb rentals, there is a 0.05% decrease in hotel revenue, suggesting that there is a negative impact on the hotel industry (Nadler 2014). Airbnb's business model is one that newer sharing companies such as Uber and Lyft may choose to emulate, in which case can take on the assumption that they too, will lead to a decrease in taxi industry revenue. However, the TNC-taxi relationship is different from the Airbnb-hotel relationship. While TNCs and Airbnb are both encroaching on the consumer base of existing industries, the cross elasticity is much larger for TNCs and the taxi industry. This is likely due to the similarity of services provided by TNCs and taxi services—higher similarity corresponds to higher substitutability.

The existing literature explains the reasoning behind certain traits in the taxi industry in terms of pricing regulation. For this particular industry, competition is a large threat, which may explain the heavy resistance to new app-based transportation networks. As evidenced by the UCTC survey, 39% of respondents choose to take a taxi if TNCs are unavailable; thus the two services are expected to have a very similar consumer base. However, Transportation Network Companies claim to fulfill a new and previously unmet demand for mobility through technological convenience. This new form of transportation increases the potential of better riding for all by decreasing car ownership and traffic, which may also benefit taxi drivers. While Uber and Lyft have been out for only a few years, it is possible that their growth and challenges will reflect those of sharing economies before their time. My prediction for this study is that in

the long term, Transportation Network Companies and mobile ridesharing will be detrimental to the taxi industry, acting as more of a substitute than a complement.

Methodology:

For my thesis, I use data from many different sources. As data from Transportation Network Companies is private and not easily accessible, I manually collect data, which compares the wait time, availability, and cost of TNCs and taxi services. In order to evaluate the taxi industry, I utilize data from the Bureau of Labor Statistics. This data provides information based on the employment of taxi drivers in the United States as a whole, and in several metropolitan areas. Using this data, I study trends of the taxi industry from 1998 to 2012, and evaluate whether there are regular fluctuations, or if the industry has followed a steady upward or downward trend. Then, I evaluate how these trends change with the introduction and growth of Transportation Network Companies. The areas chosen are based on popularity of ridesharing services in major cities—including San Francisco, Los Angeles, Seattle, and New York City. For data related to Transportation Network Companies, I select three of the most popular mobile ridesharing apps—Uber, Lyft, and Sidecar. I collect data from the mobile apps, their respective websites, and whatsthefare.com, a website that is designed to display accurate fare estimates across services, providing the consumer convenience to compare. The whatsthefare.com website uses distance and duration of a recommended route using GoogleMaps to calculate estimates based on a formula based on each TNC's published rates. This data includes the estimated distance, wait time, and pricing from one destination to another. This data is used to create descriptive statistics of the growth of TNC presence.

I estimate the effect of Transportation Network Companies through an analysis of Uber, Lyft, and Sidecar and employment data, to see how trends shifted in the taxi industry after TNC

inception for each metropolitan area. Additionally, I use this data to make predictions regarding whether this shift is caused solely by this new mode of transportation, a regular fluctuation in the taxi industry, or a combination of the two.

Chapter 1: Taxi Regulations & Disruption of TNCs

Since the inception of Transportation Network Companies, the taxi industry has evolved. Firms that were once at each other's throats in fierce competition are now working jointly to combat the effects Uber, Lyft, and Sidecar bring to their businesses. Cab companies in Maryland's Prince George County and Veolia Transportation follow the old saying "the enemy of my enemy can be my friend" and make efforts in joint lobbying (Lazo 2014). As with any form of competition, the more people rallying together the more power they have, and the taxi industry is no different. Cab drivers are joining labor unions while taxi executives work together to file complaints and lawsuits, attacking TNCs from legal and political sides. While these companies bemoan the entry of a new a powerful competitor, the main complaint is that TNCs have an unfair advantage, operating without the rules, regulations and licensing requirements of traditional taxis. Regulations within the taxi industry aim to prevent the oversupply of taxis and maintain regular demand levels, thus providing a better environment for both consumers and suppliers of taxi services. Economically and socially, regulations are necessary. These policies prevent negative externalities, correct market imperfections, maintain the supply of drivers, and avoid unsafe driving behaviors. However, the introduction of TNCs negatively impacts the problems that regulations aim to solve.

Regulations are favorable for taxi drivers. Generally speaking, government regulation is implemented because it is demanded by the regulated industry and provides favorable gains for

the industry. Economic regulations in taxicab markets exist because of the presence of negative externalities such as air quality, traffic congestion, and asymmetric information. With an unlimited amount of taxis, quality is bound to decrease which is bad for the consumer and incentivizes taxi companies to cut corners when it comes to costs such as vehicle maintenance. Favorable to cab companies, government regulation allows for higher fares than those that would exist in the free market equilibrium (Cetin 2013).

Besides being favorable to the taxi industry, regulations also work to correct market imperfections. The consumer reaches the taxicab service in three distinctly different ways: dispatch taxi, flag-down taxi, and cab stand. The dispatched taxi is monitored by a central office, which communicates calls to their drivers through radio, while the flag-down taxi is hailed on the street and cab stands provide prime locations such as hotels and airports for drivers to queue and wait for riders. Economies of scope and scale lead to uncompetitive conditions, as larger taxi companies are able to operate more effectively than smaller ones (Schaller 2007). Additionally, consumers are subject to imperfect information, often unaware of the price and service offerings that would allow them to make the most informed decision in a perfectly competitive market. Other market imperfections include substantial external costs in the form of traffic and pollution, which can be corrected through a limitation of entry (Schaller 2007).

A lack of regulatory action leads to an oversupply of drivers and the devaluation of taxi licenses. Taxi industry representatives fear that increasing the number of taxi licenses will reduce profits and therefore also reduce the value of licenses. As an industry, the taxi market is unique in that the role of customer waiting time is significant (Yang 2002). According to a study performed by Maya Bacache-Beauvallet and Lionel Janin in 2012, increasing the number of licenses is both positive and negative. On one hand, it reduces the average wait time for

consumers and thereby increases aggregate demand; conversely, additional supply reduces the individual demand met by each taxi driver, decreasing marginal revenue and marginal profit (Bacache-Beauvallet 2012). Results of Bacache-Beauvallet and Janin's econometric model conclude that the value of a license is positively and significantly correlated to many external factors, such as the existence of airports, tourism, and a large population. More importantly, it concludes that the more licenses a city has, the lower the value (Bacache-Beauvallet 2012).

Unsafe driving behaviors are also borne from a lack of regulation. Financial pressures take a toll on taxi drivers, leading to aggressive solicitation of passengers and heated arguments amongst workers. Receiving fewer passengers per hour, each ride bears a higher opportunity cost. By agreeing to service one customer, taxis forgo the opportunity to meet the demand of another. As a result, drivers seek to obtain the most valuable trips and avoid those that are short and unprofitable (Schaller 2007). Oversupply conditions also lead to generally unpleasant driver dispositions and immoral practices, such as unfairly charging customers at the end of a trip and taking longer and more inefficient routes, thus exploiting the imperfect information that exists between drivers and passengers. Forced to accept lower revenue, drivers are likely to cut corners when it comes to car maintenance, and taxicabs are known for distasteful smells and grimy interiors. In his analysis of the US and Canadian experiences for taxi regulation, Bruce Schaller notes the persistence of oversupply conditions is the result of low or nonexistent entry costs, imperfect information, low skill levels for drivers, and lack of other employment opportunities (Schaller 2007).

To combat the negative effects, there are a few commonly accepted regulatory systems in the taxi industry. First, there are open entry systems in which anyone who satisfies a basic list of licensing requirements is allowed to operate a taxicab. Then, there are Medallion and permit

systems commonly used in New York, where there are a limited number of licenses available and sold at a very high rate. Lastly, there are company-level qualifications and franchise and certificate system, which are entered only by cab companies (Schaller 2007). Regardless of the status of entry, each person or company is subject to licensing requirements ranging from background checks to demonstrations of need for the specific service. These regulations correct market and information imperfections, maintain a level supply of drivers, and limit negative externalities, creating a more pleasant environment for both drivers and passengers in the taxi industry.

While it still claims to be simply an app-based technology rather than a transportation company, Uber is essentially a modernized version of the traditional taxi. Operating free of regulations, Uber and similar companies compete against the taxi industry at a lower cost, making each ride cheaper for the consumer and more profitable for the business. The increase in supply imitates the effect that Bacache-Beauvallet studied in increased licenses, making each license lower in value and each taxi driver less profitable. The taxi industry is regulated state-by-state, and in very few places is it allowed open entry. Motivated by the opportunity to work for oneself and attracted by low entry costs, taxi drivers in open entry conditions have the potential to cause an excessive influx of workers (Schaller 2007). As Transportation Network Companies join the supply of taxicab drivers, they make it difficult for drivers to work on a full-time basis. The traditional taxicab driver is forced to give up part of his typical share of rides, and make an income that is lower than before. For Uber, a new player in this market, this isn't necessarily a problem. On its website, Uber recruits drivers by letting them know they can drive whenever they want, allowing them the freedom and flexibility of an independent contractor. Many drivers take advantage of this opportunity, working for a few hours before or after their full-time jobs,

and making supplementary income when they want a few extra dollars. These drivers are generally regarded as conversational and friendly, while their cars are crisp, clean, and almost luxurious, inside and out.

Since Uber's launch in 2009, it has been widely successful. While there are other Transportation Network Companies that run similar transportation apps, Uber functions internationally in 55 countries and is believed to be worth over $41 billion. However, the road hasn't been perfectly smooth for Uber. Protests, attacks, lawsuits, and fines have caused hindrances in Uber's success, and have come at all angles from locations around the world, including Australia, Canada, Germany, India, and the United Kingdom. As a result, there has been much political and registrative action.

In the United States, most of the political turmoil has happened in cities that use both taxicabs and TNCs readily. In Uber's headquarter city of San Francisco, Uber was served with a cease-and-desist letter claiming that it was an unlicensed taxi service and therefore committing a criminal violation. In Chicago, Uber was sued for violating city and state laws designed to protect passengers and govern fair practices. And in Seattle, the city council voted to put caps on the number of TNC drivers in order to protect the traditional taxicab industry. Just a few of the obstacles Uber has faced, these lawsuits and letters have often been settled out of court. Uber's legal team has been powerful, gathering signatures for petitions to override city and state decisions, and consumers have proven to be loyal and involved. In other cases, Uber is not so successful. In analyzing taxi employment data from the Bureau of Labor Statistics, I found that Las Vegas is the city with the highest number of taxi employees. A few cities, including Portland, Oregon, have called for the ban on TNCs, but Nevada is the only state that seems to be standing by its taxicab drivers and preventing Uber from operating due to a failure to comply

with state regulations (BLS). Given the changes regarding transportation laws and the significant impact TNCs are making, there has been wide political and registrative change among cities that use these services more readily.

Chapter 2: Consumer Preference and TNCs

Consumer preferences and constraints dictate how individuals behave in decision-making situations in all aspects of life. This applies to transportation choices, and thus it is important to know how consumers make decisions in order to understand the true impact Transportation Network Companies will have on the taxi industry. Among other preferences, travel time, cost, convenience, and perception of services influence an individual's decision of choosing the traditional taxicab or a TNC.

Travel time, which includes the wait time and the actual time taken to move from one location to another, is one of the most important attributes for all transport modes. In his study about holiday transport modes such as train, airplane, car and bus, Hergesell found that the most frequently used product characteristics regarding transport method included price and time (Hergesell 2013). Thus, consumers were often inclined to choose airplane over train, a choice that would maximize individual utility. Additionally, when asked for the top two reasons an individual chose to use an Uber or Lyft in a ridesourcing survey, 30% of respondents mentioned wait time, while another 30% said travel time (Rayle 2014). A decreased travel time leads to increased utility for consumers, as individuals try to minimize opportunity costs and increase efficiency. For TNCs and taxicabs, the actual time of travel from one destination to another is relatively equivalent, since drivers are taking the same routes and mode of transport. The wait time however, can vary depending on the procedure taken to reach a driver. Wait times for Uber, Lyft, Sidecar, and taxi are evaluated in the next chapter.

Cost and convenience also play a big role in one's choice of transportation method. Consumers typically weigh price against other attributes, which is unsurprising given the budget-conscious nature of humans. While many use taxicabs and car services only during times of vacation and travel, those that live in busy cities are more likely to use them on a daily basis to avoid dealing with concentrated traffic, car fees, and time lost searching for a parking spot. With constant use, costs are bound to build up, and thus it may be valuable for consumers to evaluate differences in transportation price. For those who do not own vehicles, the car services may seem additionally attractive due to costs associated with car ownership. Hergesell found that aspects of convenience play a secondary role only to price and time aspects (Hergesell 2013). By nature, TNC apps have an advantage due to accessibility. With the exception of upfront costs such as the purchase of a smartphone device, these transportation apps are free to download and easy to use. In order to reach a driver, a rider simply opens his app and taps "set pickup location." The app uses GPS services to locate the exact location of a smartphone, send the location and contact information to the nearest driver, and notify riders of the remaining time before a car arrives. Fast, reliable, and efficient, TNCs take the guesswork out of transportation.

The top reason collected in the ridesourcing survey for using a TNC service was ease of payment (Rayle 2014). Uber, Lyft, and Sidecar provide an added convenience by allowing consumers to pay directly from their phones. At the end of a trip, the rider is billed directly to a preset card in the app, and both parties are ensured that payment has been received. For some, this method of payment is definitely preferable, however it is less attractive to others. The perception of these services is likely to be linked to the use of technology, and younger populations associate technology with efficiency. Older generations who have not grown up in a technological world are often less trusting of online payment methods, and may find it more

convenient to pay manually at the end of a trip, with the option to use alternative forms of payment.

Chapter 3: TNC Data Analysis

The accessibility of apps on the smartphone gives Transportation Network Companies the edge in reaching their consumer base. Smartphones, whether they be iPhones, Androids, or otherwise, have become increasingly popular and necessary, especially in the new age of technology and innovation. However in deciding a method of transportation, riders consider not only convenience but also efficiency, which is most readily measured in estimated wait times and levels of pricing. According to the intercept survey conducted by the University of California Transportation Center, ridesharing customers chose to transport themselves in an Uber of a Lyft due to a variety of reasons, including 30% for the "short wait time" and 10% for "cost (cheaper than alternatives)," which makes these two factors important for consideration (Rayle 2014).

I studied the impact using nine major cities in the United States: Boston, Chicago, District of Columbia, Los Angeles, New York, Philadelphia, San Diego, San Francisco, and Seattle. To determine a place of pickup that was relatively equivalent in density for each of the nine cities, I made use of data I found in UberBlog, a blog created by Uber to share data findings, promote new programs and app features, and feature news about expansion worldwide. One post, titled "Mapping a City's Flow Using #UberData," studies how people moved from point A to point B, pinpointing each location with circles of different colors and sizes to represent popularity (Voytek 2012). Using the maps provided, I chose the most popular location in each city based on flow of traffic, and used that location as my point of pickup. I then chose another relatively dense location between five and ten miles away as the destination point. My aim was

to compare the services of Uber, Lyft, Sidecar, and taxi by using the same pickup and destination locations for 6 different time periods throughout the day. I decided to evaluate the wait time and pricing by collecting data at 12 AM, 4 AM, 8 AM, 12 PM, 4 PM, and 8 PM over each city's respective time zone.

In order to evaluate differences in wait times, I collected data manually from Uber, Lyft, and Sidecar mobile applications, as well as the website whatsthefare.com, which computes estimates for distance and duration of time based on a recommended route according to Google Maps. On average, the wait time for an Uber ride was 3.35 minutes, approximately 30% faster than its immediate competitor, Lyft, which has a wait time of 4.38 minutes and over 100% faster than Sidecar, which had an average estimated time of arrival of 6.86 minutes. The variance of the different companies also produced interesting results. Uber had a variance of 4.01, Lyft 7.50, and Sidecar 10.23. While this variation is partially dependent on the different distance lengths traveled in each of the cities, there was also variation within cities. In San Diego, for example, Uber stayed pretty consistent, yielding results of 3 to 5 minutes of wait time, while Lyft ranged from 8 to 11 minutes, and Sidecar varied from 6 to 13 minutes. With lower variances, Uber and Lyft are more consistent, and consistency gives riders a feeling of reliability and convenience. Sidecar's average of 6.89 minutes and high variance of 10.23 may be a result of its status as a less popular app, but Sidecar is also subject to unique characteristics that set it apart from its counterparts, which will be mentioned later in this chapter.

Uber, Lyft, and Sidecar compete against one another; however, they also compete against the traditional taxicab. I collected taxi arrival time averages from the 2006 Taxi Availability Survey conducted in San Francisco, which was a field study measuring the taxi availability for each of four means of obtaining taxi services (Q2 2006). As taxi services are usually called in or

hailed from the street, I decided to use two different taxi wait time estimates: average dispatch time and average hail time, as reported from the survey. In the dispatch survey, a total of 636 dispatch calls were made from several geographic regions in San Francisco, resulting in an average time of 9.38 minutes between when a taxi was dispatched to its arrival at the prearranged location. The flag down survey had a total of 300 attempts, each attempt given 25 minutes before being deemed unsuccessful; the average time for a successful flag down was 4.62 minutes. For comparison, both taxi and TNC wait time averages are depicted below in Chart 1. All three of the ridesharing companies had lower wait time averages than the average dispatch time of 9.38 minutes, and two of the three had lower averages than the successful average flag down time of 4.62 minutes. This makes leading ridesharing company Uber approximately 180% faster than the dispatched taxi service and 38% faster than a flag down taxi. Even Sidecar, with an average of 6.89 minutes, is 36% faster than a dispatched taxi. Assuming that a shorter wait time is preferable to a longer one, the Transportation Network Companies prevail in terms of estimated time of arrival.

Chart 1: Wait Time (Minutes)

	UBER	LYFT	SIDECAR	DISPATCH TAXI	FLAG-DOWN TAXI
AVERAGE	3.35	4.38	6.86	9.39	4.62
VARIANCE	4.01	7.50	10.23	-	-

Wait time is an important deciding factor in one's mode of transport, however it isn't the only one that matters. In San Francisco, where the UCTC intercept survey was conducted, public transport is prominent, which may explain why only 10% of the respondents cited cost as a reason to take a TNC. However, in other cities such as Los Angeles, public transportation is not so readily accessible, and therefore costs of car transport services are more important. To collect data on the cost of using Uber, Lyft, Sidecar, and taxi services, I used whatsthefare.com, a

website that automatically computes pricing based on each service's publicly published rates. Uber and Lyft calculate pricing in a very similar way, with rides generally $1 to start, with $1.50/mile, and $0.25/minute. Sidecar is unique in that it allows drivers to set their own price, whether it is high or low, and taxicabs calculate their fees with a formula that includes a 15% standard tip. For comparison, I have included Chart 2 below, which depicts price averages and variations for each TNC and the traditional taxicab. For a trip of 5-10 miles, the average cost was $16.70 for Uber and Lyft, $17.61 for Sidecar, and $26.23 for the traditional taxicab. Uber and Lyft services are approximately 57% and Sidecar approximately 49% cheaper than the taxi service, a substantial amount of savings for any consumer. In a normal everyday use of car services, Transportation Network Companies beat out the taxicab, and consumers can expect to save money with each ride.

Chart 2: Price (Dollars)

	UBER	LYFT	SIDECAR	TAXI
AVERAGE	$16.70	$16.70	$17.61	$26.23
VARIANCE	11.00	15.68	52.19	26.32

In non-normal circumstances, this expectation does not hold. At high-demand times such as special events and holidays in which there is an increased need for transportation services, Uber and Lyft do not stick to their published rates, and instead enact higher pricing. This system of increased pricing is called "Prime Time" for Lyft and "Surge Pricing" for Uber, however the two differ in that Lyft charges up to 200%, while Uber has been known to charge as much as 7 to 8 times its original cost. Essentially, this means that a ride normally costing $10 could hit a maximum of $30 in Lyft Prime Time or $90 in Uber Surge Pricing. During these times, it is often more cost-efficient to call a taxicab, as prices for taxis are not subject to a price multiplier effect. This is an important distinction between TNCs and taxicabs, as it gives reason for why

consumers may not choose to switch to services such as Uber and Lyft. The pricing provided by taxicabs is attractive, as it is shows consistency and reliability of prices, which represent a lower risk and a higher utility for most individuals. Before using a TNC service, individuals weigh the benefits of lower risk against the benefits of lower average cost. This may partially explain the age variation for TNCs, as younger individuals tend to be less risk adverse than older individuals.

Apart from wait times and costs, reliability also means that a service is available at all times. In my data collection for TNCs throughout 6 evenly spaced times within the day, availability is defined as the ability for a customer to obtain service at a given time. Chart 3 lists each TNC and taxi availability as a percentage calculated by the number of successful attempts divided by the number of total attempts and multiplied by 100. I found that Uber was available 100% of the time, while Lyft was a close second at 96%, and Sidecar third at 87% of the time. To compare, I used results from the 2006 Taxi Availability Study, which found that 49% of all dispatch attempts resulted in a cab arrival, 65% of taxis successfully dispatched showed up, and 95% of flag down attempts were successful (Q2 2006). Uber, Lyft, and flagged-down taxis all have a success rate of 95% or above when evaluated throughout the day, making them increasingly attractive to customers.

Chart 3: Availability (Successful attempts/total attempts x 100)

	UBER	LYFT	SIDECAR	DISPATCH TAXI	FLAG-DOWN TAXI
PERCENTAGE	100%	96%	87%	49%	95%

Results from my own data analysis and that of the 2006 Taxi Availability survey suggests that Transportation Network Companies have the advantage when it comes to consumer preferences in wait time, cost, and availability. I conclude that on average Transportation

Network Companies produce shorter wait times and more cost-efficient prices for their customers, while availability is about the same in the majority of the services. Differentiating taxi service as dispatch and flag-down, and using the outcomes from the data collected on 9 major cities, I created an approximate ranking for the services from most attractive to least attractive: Uber, Lyft, flag-down taxi, Sidecar, and dispatch taxi.

Chapter 4: Taxi Employment Trends

To study the impact Transportation Network Companies have had on the taxi industry, I looked to the Bureau of Labor Statistics to study employment trends in the last few years. I started with the metropolitan areas of the nine major cities in the United States: Boston, Chicago, D.C., Los Angeles, New York, Philadelphia, San Diego, San Francisco, and Seattle. As major cities, they are the most likely to be immediately impacted by TNCs who target cities in which transportation is vital and therefore high in demand. Upon examining the number of employees and number of establishments per city per year, I found a great disparity in the size relative to the size of the city and popularity of taxicab use, and thus focus mainly on the yearly trends exhibited by each metropolitan area.

For the number of taxi employees in each city, I found that each city seems to follow its own trend. Likely dependent on the evolution of city culture and increase of popularity or necessity to be in a certain city, some exhibited a huge jump during one year, while others maintained a slight fluctuations over time. In 2003, there is a drastic change in taxi employment for a few of the cities. Washington D.C. metropolitan area shot up from an absolute minimum of 452 employees in 2002 to 1194 in 2003 and the Seattle metropolitan area shifted from the 20-99 employee range to 250-449. On the other hand, Philadelphia and Chicago experienced negative

shifts in employment, Philadelphia moving from 250-499 in 2002 to the 100-249 in 2003, and Chicago from the 500-999 range to 250-499. After 2005, San Diego experiences a permanent drop from its normal employment, moving from the upper 200s in the 1998 to 2004 period to the 50s and 60s from 2005 onward. Most of these shifts seem to be regular cycles of recession and inflation, which lead to the hiring and firing of employees, with some cities taking bigger cuts than others.

The largest change occurs in the period between 2008 and 2010. This is likely a result of the Great Recession in 2007-2009, which led to decreased demand for many goods and thus necessary labor cost cuts for industries and individuals. The taxi labor data exhibits a relatively large dip in employment during these years. As Uber was introduced to cities beginning in 2011, I studied the data for rebound trends following the Great Recession and wanted to see whether cities that had a TNC presence would have a less favorable rebound curve due to the introduction of this new form of transportation. I compare this data to employment data in Las Vegas, where TNCs such as Uber and Lyft are not allowed to operate. Of the cities with TNCs, more than half were able to rebound completely and even increase employment, including Boston, Chicago, D.C., Los Angeles, and San Diego. Others, including Uber, Lyft, and Sidecar's origin of San Francisco stayed at the same level.

In Figure 1, each city is represented by a line, which follows the employment trend through out the years 2007 to 2012. Figure 2 does the same for Las Vegas, which is the most densely packed location of taxi drivers. After 2011, all cities on Figure 1 except for Chicago and D.C. have a lower slope. For example, Los Angeles continues to increase employment but at a lower rate, and San Francisco decreases employment. When you compare Figure 1 with Figure 2, the graphs are immensely different. From 2011 to 2012, the cities in Figure 1 change an

average of 0.16%, with the highest being Los Angeles at 7.6% and the lowest being -18.4%. On the other hand, Las Vegas experienced an increase of 23.3%—a huge change given that Las Vegas' employment managed to increase from 7,314 to 9,019 in a one-year period. While other factors may contribute to this disparity, I believe that this impact could be explained by the introduction of Transportation Network Companies.

Figure 1

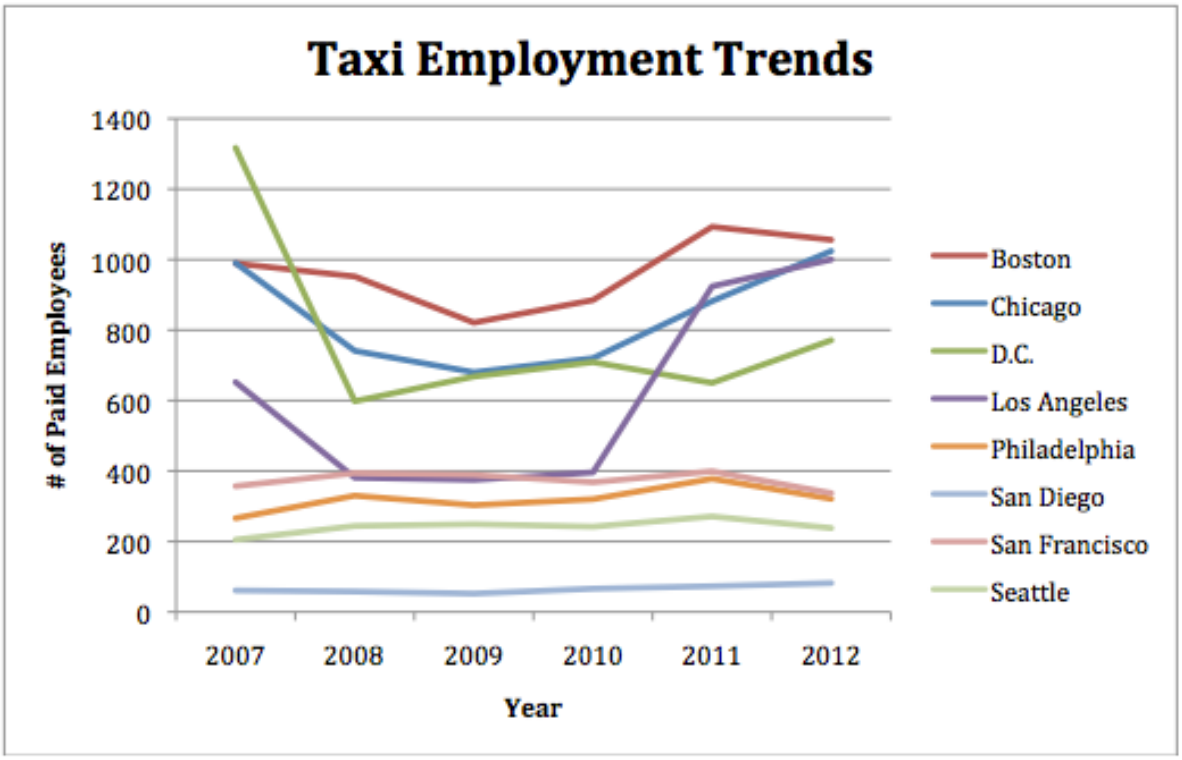
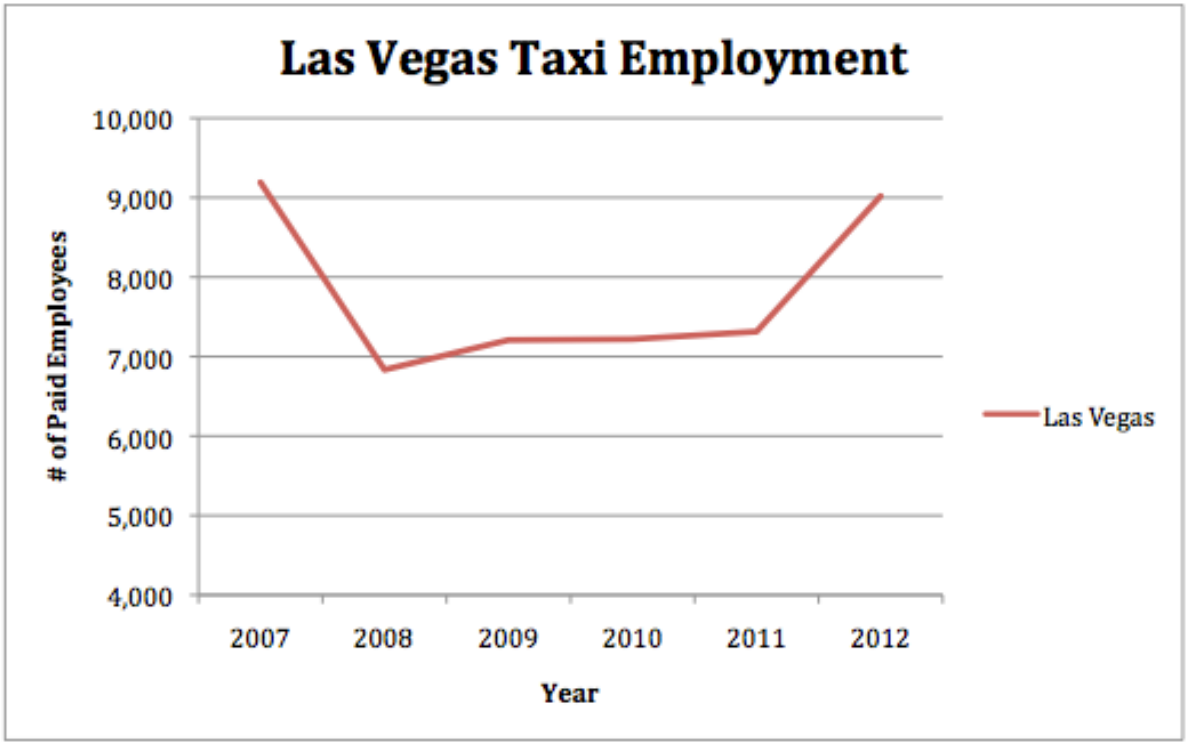
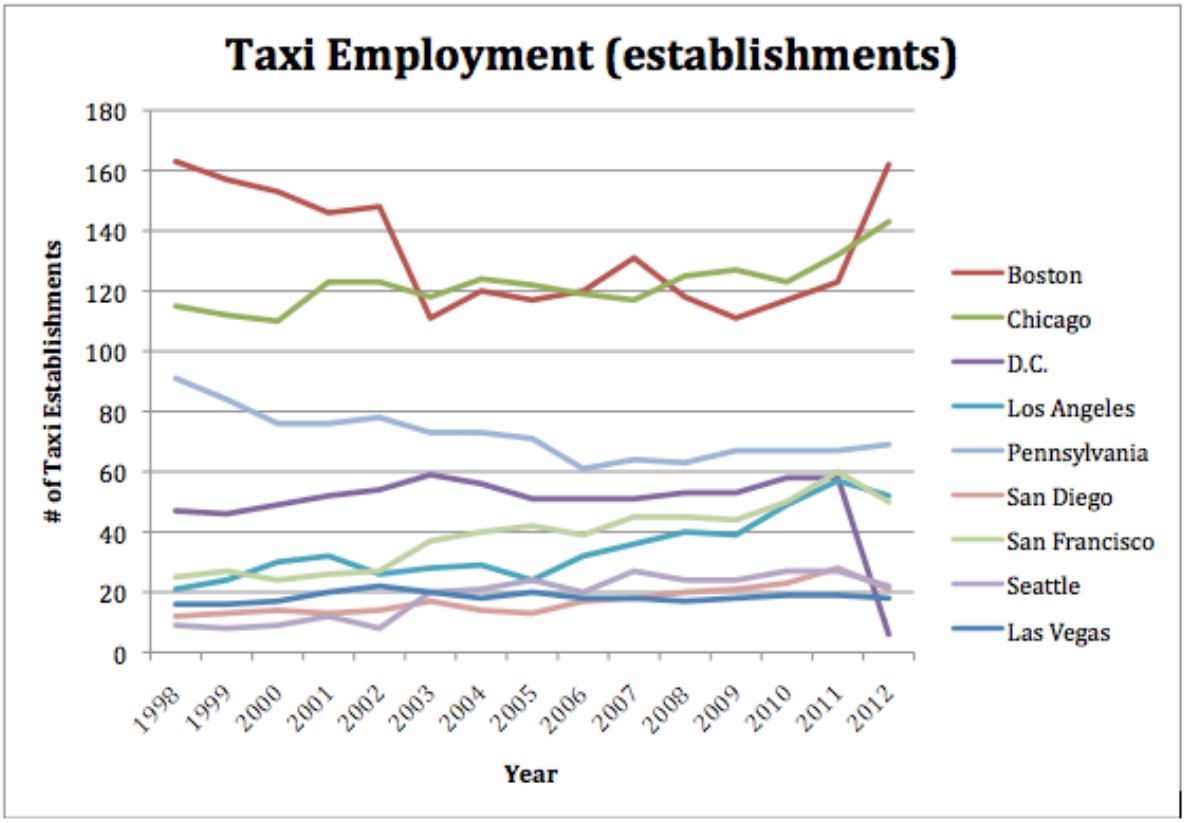


Figure 2



I also evaluated the yearly data for total taxi establishments, which measures the number of business organizations that supply taxi drivers in any given metropolitan area. While this number is not completely reliable due to varying sizes of establishments, it nonetheless follows a similar trend to the data for paid employees. Additionally this data is more accurately represented since there are a specific number of establishments listed for each year, whereas the paid employee data gave estimated ranges for years 1998 to 2006. Figure 3 illustrates the trend for establishments in eight major metropolitan areas and Las Vegas from 1998 to 2012. Most cities show a decrease from 2011 to 2012, representing the same result produced by the Figure 1. Las Vegas features a relatively constant slope, ranging only from 16 to 22 in a span of 15 years.

Figure 3



The difference in taxi trends for areas in which TNCs are readily available and Las Vegas can be influenced by the introduction of companies such as Uber, Lyft, and Sidecar. In order to maintain employment and increase profits, taxi employees may have decreased in the metropolitan areas where TNCs are prevalent, and instead shifted their services to places in which TNCs are banned, the most prominent city being Las Vegas. A prime tourist and weekend getaway destination, Las Vegas is undoubtedly one of the most necessary places for taxis. The demand for taxis is likely attributed to the cold nightly weather conditions, fast-paced culture, and the plethora of taxi stands outside every major hotel, nightclub, and casino. Taxicabs provide a faster method of transportation from Point A to Point B, allowing consumers to do more in a short amount of time. The local government has the incentive to protect taxis in Las Vegas

because of its long-standing history with the taxi industry, which has consistently abided by state transportation laws. With average of 7,644 paid taxi employees, the Las Vegas taxi industry is highly consolidated and the influx of employees from other areas of the United States does not seem to impact the number of establishments created. As TNCs become more prevalent, trends for paid employees and establishments may change due to oversupply and new regulations.

Chapter 5: Costs & Benefits of TNCs

At the very least, apps such as Uber, Lyft, and Sidecar have provided consumers with the freedom of choice. These companies expanded quickly and have made an impact within a matter of years, however this impact is not solely positive. Although TNCs have the potential to improve welfare for some individuals, it is likely to be at the expense of others. To gain a thorough understanding, it is important to weigh the costs and benefits associated with using Transportation Network Companies instead of the traditional taxicab.

The benefits are relatively obvious. As evidenced by the data collected in Chapter 3, Uber, Lyft, and Sidecar are all more cost-efficient, with Uber and Lyft approximately 50% cheaper than the traditional taxicab. When it comes to travel time, the data shows that all three TNCs are faster than the dispatched taxi, with Uber and Lyft beating out the flag-down taxi. The convenience that is provided through using a mobile app is undeniable. Free and available on a variety of platforms, Uber is especially accessible for those who already own smartphones. These apps also bring an added transparency. Information regarding the trip length, price, and wait time was previously skewed towards the driver, or the supplier. With these new apps, consumers are more aware of these trip aspects, as well as what they could receive from a

competitor, even before ordering a service. Thus, smartphone technologies provide a valuable transition from traditional forms of information (Brazil 2013).

There are both explicit and implicit costs of TNCs. The explicit costs are upfront. In order to use any TNC mobile app, it is imperative to have a phone with both GPS-tracking and Internet capabilities. These phones are originally sold for hundreds of dollars, but depending on the age, model, and physical quality of a phone, it may be available for less than $100. With the purchase of a smartphone, the consumer also purchases a data package. These packages range in size and speed for each provider, and thus some may be more expensive than others. In addition, a consumer may choose to purchase insurance, accessories, and other features, making it likely to spend $500-$1000 annually on a smartphone. To some consumers, this may seem like a reasonable cost; however, for others including the low-income population, this is an extravagant expense.

The biggest implicit cost is derived from the potential impact TNCs can have on taxi drivers. Uber, Lyft, and Sidecar use strategic marketing tactics. Riders are encouraged to distribute their individualized promo code to new users, and as a reward, both parties receive a free ride (up to $20). This tactic incentivizes riders while simultaneously spreading word about the mobile transport service, and has been widely successful. However, if TNCs continue to gain momentum and convert riders, this could lead to the decline of the taxi industry and unemployment for the 50,470 taxi drivers currently reported on the Bureau of Labor Statistics (BLS). Due to an oversupply of car services, riders will choose the one that is most closely aligned with their preferences and will maximize their utility. With shorter wait times, cheaper prices, and added convenience, TNCs are likely to fit the mold better than taxi drivers.

Some TNCs also have the added cost and controversy of increased pricing. For Uber, this method of pricing is called "Surge Pricing," which can multiply the normal price by 7 or 8 times. Surge pricing encourages and incentivizes driver to get on the road during times of high demand and especially times in which people are most reluctant to get in their own cars and drive. These peak times are typically expected immediately before and after work times, as well as after popular events and gatherings. However, surge pricing can't always be predicted. During Hurricane Sandy in 2012, Uber was criticized for raising prices in a time of high stress and danger ("A.G. Schneiderman" 2014). In this dangerous price surge, consumers were forced to choose between their own safety and the cost of a very expensive ride. While Uber is working to set a price cap during natural disasters, problems such as the surge pricing problem is reflective of the young age of TNCs. Unlike taxicabs, they have not dealt with all the problems that come with operating a transportation service, and are thus more likely to create unexpected costs to consumers.

While it is for the individual to decide whether the costs outweigh the benefits, there may be ways to mitigate the costs of transitioning from taxi to TNC. It would be optimal for the competitors to work jointly in efforts to minimize unemployment for taxi drivers. Perhaps TNCs could work towards employing former taxi drivers or provide compensation that would be favorable to both parties.

Predictions

While my research on the impact of TNCs on the taxi industry is not conclusive, it does lean towards one particular outcome. The combination of minimal regulation, low prices, short wait time, and certain preferences gives TNCs an advantage over taxi companies. And although

Uber, Lyft, and Sidecar have come under fire recently, the barriers to entry have been relatively low. Additionally, the new age of technology refuses growth to taxicab companies, who have made few technological changes throughout the years. Despite their success, Uber and Lyft continue to find new ways to innovate. Recently, Uber and Lyft introduced UberPool and LyftLine, carpooling services that allow riders to share rides and split costs with others traveling a similar direction. Uber has also introduced Uber for Business, UberFamily, and UberRush, each with features that appeal to different demographics. Assuming that TNCs continue to function under current circumstances, I predict they will have the ability to drive out the taxi industry.

The taxicab industry is heading towards stagnation; but I believe that certain modifications could change its direction. First, regulation for Transportation Network Companies must increase. The reason taxis charge more is a result of additional regulation costs, which increase price and decrease demand for the taxi service. Without the same level of regulation, taxicabs and TNCs are competing for a similar consumer base on uneven playing fields. Next, taxis must improve their technology and communication methods—an update that is long overdue. By evolving with the general population's interests, the taxi industry is more likely to be successful. It would be beneficial to create an app similar to those created by TNCs. Lastly, the taxi industry must seek innovative ways to re-recruit riders. Taxis have the advantage of time and experience, and unlike TNCs, they have been around for over a century, surviving through the darkest economic times. In order to stay competitive with a company like Uber, taxi companies must be innovative and strategic in their methods.

Limitations of Research

In performing research on the effect of Transportation Network Companies on the Taxi industry I faced a number of challenges. The first challenge exists because of the private status of TNCs. Uber, Lyft, and Sidecar were all founded within the last six years, and although their success is insurmountable, public ride data is nonexistent. Besides UberBlog, a blog that posts occasionally about data findings, there is very little information about how many rides are given a year, the average wait times, and number of employees. However, Uber, which is worth $41 billion, is rumored to IPO in 2015. This momentous event would transform Uber into a public company and provide the data needed to build econometric models.

To evaluate the taxi industry, I looked to the Bureau of Labor Statistics in order to gather employment data. I found both national and metropolitan area-level data, which reported the number of taxi drivers and establishments, as well as the first-quarter and annual payroll, from 1998 to 2012. This data was essential to analyze employment trends for taxi drivers prior to the introduction of TNCs. Much of the employment data was useable, however I found complications in assessing trends through years 1998 to 2006. Many of the values were written in ranges such as 250-499 and 500-999, likely a result of the unavailability of employment data. This restricted a more accurate graphical representation and analysis of taxi trends over time. The nature of the Bureau of Labor Statistics may also lead to inconsistencies. As employment is self-reported, it is uncertain whether Uber, Lyft, and Sidecar drivers have been reporting themselves under the title of taxi driver. I moved ahead with the assumption that TNC drivers were not reported as taxi drivers because of two reasons. Firstly, Uber has been known to recruit employment with the basis that employees can work whenever they want. As a result, many are part-time contracted drivers who work at separate full-time jobs during the day. Secondly, Uber

claims to be an app-based technology company rather than a transportation service, and thus employees may not see themselves as taxi drivers.

One last limitation was a lack of research previously performed on this subject. I found limited research surrounding the topic of Transportation Network Companies. As Uber, Lyft, and Sidecar are constantly in the media, there is plethora of news reports and speculation, however they are often unfounded. This reflects the ever-changing nature and young age of TNCs, and I expect that there will be an increasing flow of publications as data becomes public.

Conclusion

Since their inception six years ago, Transportation Network Companies have already made a significant impact on the taxi industry. These companies entered the market without the restrictions and regulations that serve as barriers of entry for traditional taxicab drivers. As a result, this advantage allows TNCs to operate with lower costs, and therefore provide better prices to consumers. Like all other service-oriented industries, the transportation industry is reliant upon consumer demand. Riders will always choose the service that provides them with a higher utility based on individual preferences. For transportation, the top three preferences are variations on speed, convenience, and low pricing.

In my side-by-side comparison on Uber, Lyft, Sidecar, and taxis, I found that TNCs often cut the wait time in half while charging a fraction of the price of a taxi service. With these results, it is obvious why TNCs have had such an immediate impact. Through the years, the employment of taxi drivers has fluctuated with changes in the economy. However, after the latest dip in employment in 2008-2010, it seems that some states rebounded better than others. Las Vegas, which banned TNCs, maintains a steady growth; other cities such as San Francisco and Los Angeles have taken a hit.

Weighing the evidence, I make the prediction that TNCs will eventually take over the taxi industry at current conditions. Despite the odds, traditional taxicabs have the power to stay competitive as long as changes are made regarding regulations and improved technology.

In future studies of the economics impact of TNCs on the taxi industry, I suggest using updated employment data. Due to the delay that comes with obtaining information, I could only use Bureau of Labor Statistics taxi employment data up to 2012. Uber, Lyft, and Sidecar, which are only a few years old, are likely to make a bigger impact in the years immediately following 2012. Taxi employment is expected to decrease as a result of a lower demand, and thus firms will need to cut labor costs. I also suggest a future econometric study using comparing TNC and taxi data about the number of rides taken, wait times, pricing, and density of cars in a given region. This data is not currently available to the public, however upon the pending IPO, Uber will become a public company and thus information will be more accessible.

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