Master Thesis in Economics

Creative Destruction of Sharing Economy in Action

- The Case of Uber -

공유경제로 인한 창조적 파괴의 과정

- 우버의 사례를 중심으로 -

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Abstract

Creative Destruction of Sharing Economy in Action[1]

- The Case of Uber -

This is an empirical examination of how Uber has transformed the traditional taxi industry in New York. In order to do this, I developed a regression model controlling for various factors that may affect taxi trips and found no direct evidence that the number of taxi trips, the revenue per driver, or occupancy rates have decreased since Uber entered the market. However, a closer investigation into other dimension, specifically the degree of dispersion of pick-up and drop-off locations, reveals that taxi drivers have been forced to change their way of doing business in order to retain their market position. Since Uber has crowded out taxis from the central area of Manhattan, taxis have actively responded by serving customers outside the area. By enlarging their geographic coverage and serving customers that were previously ignored, taxis were able to retain their previous numbers for trips and their market share. Our results suggest that the incumbent taxi drivers actively responded to the disruptive threat of Uber's entry and consequently have provided substantial benefits to consumers as they can hail taxis from a wider area of

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New York. I thus found that the sharing economy has transformed the existing market in a positive and welfare-enhancing way. This paper presents managerial as well as policy implications for how incumbents under the threat of sharing economy should respond. Our results suggest that traditional taxis have defended themselves well against Uber's entry thus far. Without an active response of searching for a new market, they would have been severely hit by the business-stealing effect from Uber. I conclude that the sharing economy can coexist with the existing economy to create positive values in our society through well-intentioned competition that complements each other's weaknesses and strengths.

Keywords: Sharing economy, collaborative consumption, Uber, creative destruction, marketplace, disruptive innovation

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Chapter 1. Introduction

1.1 Research purpose

What impact does sharing economy have on existing businesses? Are incumbents in real threat of being substituted by the disruption that sharing economy brings into our society or is it just being overestimated? *The Economist*[2] examined whether Uber substituted the incumbent yellow taxis and suggested that Uber had a business stealing effect on taxis rather than complementing them. On contrary, Clayton M. Christensen, on *Harvard Business Review*[3], mentioned that Uber might have led to a new increased total demand by developing a better, less-expensive solution to a widespread customer needs. As such, there is currently a controversial issue surrounding Uber's impact on existing businesses.

Among various stakeholders that may have been affected by Uber, this paper empirically examines how Uber transformed the traditional taxi industry in New York. As an extension to previous studies on Uber, this paper analyzes several dimensions of taxi trip records that Uber might have affected and examines the consequent responses that incumbent taxis have executed. This empirical research provides managerial implications on how incumbents in treat of disruption of sharing economy should respond as well as policy implications on how sharing economy can harmonize with the existing economic

[2] Douglas Macmillan and Telis Demos, "Substitution or complements?", *The Economist*, 10 August, 2015, http://www.economist.com/blogs/graphicdetail/2015/08/taxis-v-uber
[3] Clayton M. Christensen, Michael E. Raynor, and Rory McDonalds, "What is disruptive innovation?", *Harvard Business Review,* December 2015, https://hbr.org/2015/12/what-is-disruptive-innovation

system.

1.2 Research background

The rise of sharing economy, in other word collaboration consumption in the 21st century has been widely appraised as an alternative that can resolve various socio-economic and environmental problems today. Those possessing an extra bedroom can post it on a sharing-platform such as Airbnb and those with an idle vehicle on the garage can participate in ride-sharing activities through Uber or Lyft. Sharing economy, facilitated by the diffusion of internet and mobile application, allowed us to participate in on-demand activities in more efficient and convenient manner. The scope of sharing activities extends to a wide range of on-demand and O2O (online to offline) activities from house-cleaning, caregiving to crowd-funding and knowledge sharing.

Despite its potential value, some questions the tangible value that sharing economy brings in our society. Sharing economy has been often criticized as being the 'share-the-scraps economy'[4] where big money goes to platform owners and the scraps go to the participants. In addition to this debate, several countries including Korea[5] legally suspended Uber's operations and the lack of security and safety mechanism on accomodation-sharing and ride-sharing posed several doubts about its potential growth.

Thus, it is crucial to analyze what impact sharing economy has on incumbents and

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[4] Robert Reich, "The Share-the-Scrap Economy", last modified February 02, 2015, http://robertreich.org/post/109894095095

[5] Hope King, "Uber suspends UberX service in South Korea", *CNN*, 06 March, 2015, http://money.cnn.com/2015/03/06/technology/mobile/uber-suspends-uberx-in-south-korea/

what destruction or creation it brings into our society. A profound investigation on the relationship between the entry of sharing economy and the affected incumbents can unveil such controversy and accurately predict the future of sharing economy.

1.3 Research design and contribution

Among various industries that sharing economy is disrupting, this paper focuses on the transportation sector, more specifically the taxi industry. Using the taxi trip record data that New York City Taxi & Limousine Commission (TLC) provides I compared several dimensions of taxi trip records before and after Uber entered the market. As our data spans from 2009 to 2015 and Uber was launched in New York on May 2011, 4 years of post-Uber entry data is currently available.

I developed a regression model controlling various factors that may affect taxi trips and found no direct evidence that the number of taxi trips, the revenue per driver, or occupancy rates have decreased since Uber entered the market. However, a closer investigation into other dimension, specifically the degree of dispersion of pick-up and drop-off locations, reveals that taxi drivers have been forced to change their way of doing business in order to retain their market position.

I found an increased degree of dispersion of pick-up and drop-off locations which implies that that taxis started to cover a larger geographic area of New York since Uber entered the market. This also refers to the fact that taxis were crowded out from the central area of Manhattan due to an increased competition. Incumbent taxis started to pick

up customers from a more dispersed area of New York and their active responses in threat of Uber made them possible to retain their previous level of taxi trips, earnings as well as occupation rate. From the findings above, I find that a form of destruction clearly occurred among incumbents as taxi drivers were crowded out of the central Manhattan area. However, I also find that incumbents actively respond to the treat of entry by changing their routines.

If we examine Uber's effect from the consumer's perspective, customers can now hail taxis in a wider areas of New York as taxis started to serve customers that had been previously ignored. This implies that customers benefited the most from the competition between incumbent taxi and Uber. This conclusion aligns with the economic theory that higher competition leads to an augmented consumer welfare.

Our paper makes several important contributions complementing previous studies. This paper provides managerial and policy implication on how incumbents affected by the disruption of sharing economy should respond. Even though it might be yet premature to examine the comprehensive effect of Uber, our result suggests that incumbent taxis well defended Uber's entry so far. Without a proactive response of searching for a new market outside the Manhattan, incumbent taxis would have been severely hit by the business stealing effect of Uber. I can finally conclude that with the combination of the incumbents' responses, sharing economy do transform the existing market in a welfare-enhancing way.

The remainder of this paper is organized as follows: The next section reviews the

existing literatures and the following section presents the hypothesis. Our data and methodologies are introduced followed by empirical results. Finally, I conclude with a discussion of our results and their implications.

Chapter 2. Literature review

2.1 Theoretical background

Entry of a firm in a market has been a major area of study in both management and economics. The relationship between entrant and incumbent can be explained by the concept of creative destruction, a process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one (Schumpeter, 1942). At a national or industry level, several studies theoretically and empirically examined the Schumpeter's process of creative destruction and suggested that high level of creative destruction was associated with economic growth (Aghion and Howitt, 1990; Reynolds, 1999; Aghion et al. 2004). Levinsohn and Petropoulos (2001) empirically examined whether a creative destruction or pure destruction occurred in the textile and apparel industry from a long historical data and found that productivity increased in both industries due to an intensified international competition.

The question whether an entrant with a disruptive business model or technology substitutes the existing market or leads to a market creation has been an important issue in industry dynamics. Several literatures analyzed the effect of P2P file sharing on the purchase of CDs in Canada and presented contradictory results. Some research found no association between the number of P2P files downloaded and CD album sales and some claimed that market creation effect was higher than substitution effect (Andersen and

Frenz, 2007; Andersen and Frenz, 2010; Barker and Maloney, 2012; Liebowitz, 2008).

One of the stylized facts about entry is that it is often associated with high rates of innovation. Many studies show that entry stimulates incumbents to introduce new products and processes which they had been holding back (Geroski, 1995).

In real business setting, entrants affect the existing market and incumbents in unexpected ways due to the dynamic nature of firms. Firms faced with a new threat of competition by an entrant tend to actively respond by changing their business model or strategies (Christensen et al. 1998; Lee 2003). Christensen, on his book called *'The Innovator's Dilemma'*, claims that incumbents should actively explore any disruptive entrants and actively respond to it in order to survive in today's highly competitive and fast changing world.

It is identically important to mention that the impact of entrants on incumbents and existing market is not uniformly same. How the existing market is compromised, what the market specific characteristics are and how different stakeholders are interlinked within the market lead to a different impact of a new entrant. Seamans and Zhu (2014) empirically analyzed the impact of Craigslist in multi-sided market with three sides and found that Craigslist's entry at one side affect other sides as well.

The specific characteristics of entrants may also impact the incumbents in different ways. Prince and Simon (2015) examined whether the incumbent airline companies improved their service quality in response to an entry of low-cost carrier (LCC) and found that incumbent's on-time performance (OTP) actually worsened since Southwest

Airlines entered the market. The fact that Southwest Airlines was not only a top-performer in service quality but also a low-cost carrier led incumbents to respond through cutting costs which ultimately lead to a drop in service quality. In micro-economic theory, it is known that frequent entries and exits in a market displace static equilibrium towards the consumer welfare-enhancing way. However, this result contradicts the general belief and shed lights on the importance of considering 'who' is entering a market.

This research examines the impact of sharing economy on incumbent business. More specifically, this paper analyzes how Uber transformed the existing taxi industry in New York. The following subchapter presents a detailed review on sharing economy and Uber.

2.2 What is sharing economy?

There lacks a consensus on the definition for sharing economy (Shor, 2014). Even though sharing economy or collaborative consumption has become popular in the 21st century since Lessig (2008) mentioned on his book *'Remix: Making art and commerce thrive in the hybrid economy'*, the concept of sharing, co-producing goods and services directly from individuals has always existed since our early civilization.

What makes sharing economy special today is due the diffusion of internet and mobile applications that facilitated the transactions between the supply and demand sides. Online platform enabled people in demand of certain goods and services and those with the ownership to transact in a convenient and efficient way, lowering down the transaction and searching cost. As Coarse (1937) identified that transaction cost is the key

determinant of the existence of firms, this also provides the answer to why sharing economy is growing fast.

Sharing economy has been viewed as an alternative that can resolve various socio-economic problems and reduce unnecessary consumptions. It may offer a new, sustainable way of doing businesses and create values for the environment, people and society. (Lovins and Cohen, 2011; Stead and Stead, 2013).

Most of the current researches on sharing economy are qualitative, focusing on the business model (Cohen and Kietzmann, 2014) or success factors (Hong et al., 2012) of sharing economy. A few quantitative researches exist and most rely on survey data (Ballus-Armet et. al., 2014; Hall and Krueger, 2015). Despite an increasing trend of research on sharing economy, there still lacks empirical studies on how sharing economy is conflicting with the existing economic system.

Hwang (2015) theoretically analyzed the change in welfare before and after sharing economy entered a market from an economic perspective. Comparing the consumer's and supplier's surplus, he finds that every agent including old customers, new customers, platforms and new suppliers are better off except for incumbent suppliers. He claims that sharing economy is welfare-enhancing if business creation effect is higher than business stealing effect.

Among empirical studies, Zervas et al. (2016) analyzed the impact of Airbnb on the hotel industry in the US and found that its impact is non-uniformly distributed. The research estimated that 1% increase in Airbnb listings resulted in 0.05% decrease in

quarterly hotel revenues. Choi et al. (2015) similarly analyzed the impact of Airbnb on hotel revenues in Korea and found no significant relationship between them. He found that economic indicators including unemployment rate and exchange rate are more critical in hotel performances. Fang et al. (2015) evaluated the effect of sharing economy on tourism industry and claimed that it generated new jobs as more tourists came due to a lower accommodation cost. As such, the conflicting results of the impact of sharing economy reflect the needs for a more accurate and closer examination on sharing economy.

2.3 Taxi industry

Taxi industry is subject to a variety of potential limitations of competition that most notably include entry restrictions in many jurisdictions (OECD[6], 2007). Regulating supplies by the government is seen as an efficient way of improving social welfare. However, some market failure do arises and one possible way to resolve is through bringing in providers of substitute products and services into competition (OECD, 2007). The rise of sharing economy in the 21st century and the launch ride-sharing platforms such as Uber or Lyft are proposed as an alternative to taxi. Haggag et al. (2014) applied the concept of learning-by-doing to taxi drivers and found that taxis improved their performance through the process of learning-by-driving.

[6] OECD (2007), "Taxi services: competition and regulation"

2.4 Uber

Uber, headquartered in San Francisco, California was founded in March 2009 as a transportation network company. As a platform based company, its business model consists of Uber-drivers who use their own cars to transport consumers in need of rides. The on-demand ride service is operated by Uber's mobile platform by simply submitting trip requests and linking drivers with the consumers. Since its first launch in San Francisco it rapidly expanded in various cities in the US including New York City, Chicago, and Washington D.C on May 2011. As of February 2016, the service is available in 476 cities from all over the world[7]. The company is now valued at 50 billion dollars [8]and has become the representative sharing economy company in the transportation sector.

Among diverse geographic areas where Uber expanded, this paper focuses on New York where Uber expanded rapidly following San Francisco and Los Angeles (Hall and Krueger, 2015). The yellow taxicabs of New York are widely recognized as a representative icon of the city and several news articles suggest that yellow taxicabs are in threats of Uber's entry. The ongoing strike by taxi drivers all around the world also suggests the need for a closer examination on the relationship between Uber and taxi industry. Unveiling such controversy can lead to policy recommendations on whether regulating and suspending Uber's operations is the answer to solve the dispute.

Wallsten (2015) examined the impact of Uber on yellow taxicab in New York and

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[7] Uber Technologies Inc., accessed on 16 June, 2016, https://www.uber.com/ride

[8] Douglas Macmillan and Telis Demos, "Uber valued at more than $50 billion", Wall Street Journal, 31 July, 2015, http://www.wsj.com/articles/uber-valued-at-more-than-50-billion-1438367457

claimed that the number of yellow taxi trips decreased as Uber grew. Also, by empirically exploring the relationship between the number of taxi complaints as a proxy of service quality and Uber's entry, it claimed that taxis in New York and Chicago improved their service quality. Another study compared the fare amount of taxis and Uber and found that Uber tends to be more expensive than yellow taxis in certain circumstances (Salnikov et al., 2015).

Chapter 3. Hypothesis

3.1 Business-stealing effect of Uber

In order to examine whether Uber substituted taxi trips, the number of daily taxi trips and average daily revenue per taxi driver were measured. These variables reflect whether consumers who used to use taxi deviated onto Uber and ultimately led to a decrease in the number of taxi trips as well as daily revenue per taxi driver. The drop in the number of taxi rides after Uber's entry would support the hypothesis that Uber substituted the taxi industry. Barker and Maloney (2012) analyzed the effect P2P downloads on CD sales and found that P2P downloads reduced CD demand by around 0.4%. Wallsten (2015) analyzed whether yellow taxis were substituted by Uber and found that Uber replaced taxi trips in New York. In our model, yellow as well as green taxi trips were taken into consideration in order to investigate Uber's comprehensive effect on the taxi industry. Similar to previous studies, I can hypothesize that the business-stealing effect of Uber reduced the number of taxi trips as well as the average daily revenue of taxi drivers.

3.2 Shadow cost of taxi drivers

In addition to the tangible and direct effect of Uber above, there exists a shadow cost that taxi drivers need to endure and that would be the occupancy rate. The decrease in occupancy rate reflects the situation that taxi drivers need to travel more with an empty cab and that consumes fuels as well as striving efforts to search for customers. Zervas et

al. (2016) analyzed whether hotel's occupancy rate decreased since Airbnb entered the hospitality industry and found that a 10% increase in Airbnb supply generated a modest decrease in occupancy rate of about 0.0007%. Similarly, Uber's substitution effect would have led to a drop in occupancy rate. Due to the entry of Uber in a supplier-regulated market, I can hypothesize that Uber led to a drop in occupancy rate of taxis which reflects an augmented shadow cost for incumbent taxi drivers.

3.3 Customer welfare

It is identically important to examine how Uber affected the demand side of taxi trips. Hitt and Brynjolfsson (1996) empirically examined the value of firm's IT spending and found that it provided a substantial benefit to consumers. Similarly, the consumer theory in microeconomics shows that increased suppliers in a competitive market lead to an augmented consumer welfare. In this paper, average distance per taxi trip and geographic dispersion of pick-up and drop-off locations are measured as a proxy of customer welfare.

63% of the yellow taxi trip occurs within the concentrated area of Manhattan, south of 59th Street.[9] Even though it is required for taxis to take customers to any destination within the five boroughs of New York, many complaints were reported for being refused to travel out-of-Manhattan addresses. Despite of the introduction of increased fine for the violation, 'geographic discrimination[10]' has been common for passengers trying to hail

[9] Carl Bialik et. al., "Uber is serving New York's outer boroughs more than taxis are", 10 Aug, 2015, https://fivethirtyeight.com/features/uber-is-serving-new-yorks-outer-boroughs-more-than-taxis-are/#fn-2

[10] Marcia Kramer, "Bloomberg calls for end to taxi drivers' geographic discrimination", 9

taxis on street. Traveling within the Manhattan area is generally more profitable for taxi drivers as taxi drivers often have to return with an empty cab after dropping off the customer on the suburbs of Manhattan. Uber application provides significant benefits to customers on the outer-skirt of Manhattan where hailing taxi on the street is difficult. Therefore, I can hypothesize that taxi drivers started to take customers traveling to the outer suburbs which that were previously ignored since Uber entered the market. The increase average trip distance would reflect that taxis traveled to areas where they used to refuse.

Moreover, from Uber's rapid diffusion in both the central area of Manhattan as well as other boroughs of New York, incumbent taxis would have been crowded out of the central area of Manhattan and moved to a more dispersed area of New York. Seamans and Zhu (2013) analyzed the impact of Craigslist on local newspapers and found that incumbent local newspaper providers responded by differentiating themselves from each other. As such, I can formulate a hypothesis that incumbent taxis respond to Uber's entry by changing their routine targeting customers that were previously ignored. I can hypothesize that the dispersion of pick-up and drop-off location increased since Uber's entry and thus covered a broader geographic coverage of New York. As customers can hail taxis from a wider geographic area of New York, this would be an appropriate proxy that measures the change in customer welfare.

Mar, 2009, http://newyork.cbslocal.com/2011/03/09/nyc-shows-videos-in-push-for-cabs-to-accept-riders/

Table 1. Summary of hypothesis

#	Hypothesis	#	Proxy variable
H1	Business-stealing effect of Uber	H1.1	Number of taxi trips
		H1.2	Daily revenue per taxi driver
H2	Increased shadow cost of taxi drivers	H2.1	Occupancy rate
H3	Increased consumer welfare by Uber	H3.1	Average trip distance
		H3.2	Geographic dispersion of pick-up/drop-off locations

Chapter 4. Data and methodology

4.1 Data

This research uses New York taxi's trip record data released by New York Taxi and Limousine Commission (TLC). The micro-level data span from January 2009 to December 2015. The raw cross-sectional data include date and time of pick-up and drop-off, number of passengers, trip distance in miles, pick-up and drop-off location in longitude and latitude, payment type (credit card, cash, etc.), fare amount, tip amount, tolls amount and total amount on every trip occurred in New York.

On average, there are around 14 million trips per month and the whole trip data during the 84 months exceeds over 10 billion trips. Following the sampling technique of Sampat et al. (2003), 1% of every month's trip records was randomly sampled and acquired a data set consisting of 11.7 million trip records from January 2009 to December 2015. As our analysis examines the effects of Uber in New York on existing taxis as a whole, 1% of random sampling was conducted on both yellow and green taxis. The cross sectional trip record data is then transformed into a daily time-series data consisting of 2,556 days.

4.2 Variables

4.2.1 Independent variables

Uber was launched in New York on May 2011 and experienced a rapid expansion. Uber's trip record data since its entry would be ideal as our independent variable,

however, the acquired Uber's weekly dispatched trips and unique dispatched vehicle data from TLC are available for a limited period. Therefore Uber's entry is dummified based on the period of entry in New York.

4.2.2 Dependent variables

4.2.2.1 Number of daily taxi trips

This variable measures the daily number of taxi trips occurred in New York. The count data accounts for 1% of the population data. As I am examining the impact of Uber on the taxi industry as a whole, both yellow and green taxi trips are included.

4.2.2.2 Average revenue per taxi driver

To examine a more direct impact of Uber on taxi drivers, the individual fare of taxi trips are summed up for every separate day and then multiplied by 100 as it is a 1% randomly sampled data. This value gives the total amount of revenue earned by taxi drivers per day and this is then deflated using CPI with the base year 2009. To examine the average daily revenue per taxi driver, this is then divided by the number of medallion-licensed taxicab drivers. Even though this variable assumes that all medallion licensed drivers are on the street 24/7, this measure can roughly represent how yellow taxi driver's revenue was hit by the business-stealing effect of Uber. The number of licensed drivers in New York City ranges from 48,521 in 2009 to 53,801 in 2015. The equation deriving the average revenue per taxi driver follows:

$$revenue\ per\ taxi\ driver_t = \frac{\sum(fare\ amount_t)}{(number\ of\ licenced\ driver)_t}\ X\ 100$$

4.2.2.3 Occupancy rate

Occupancy rate can be used as a proxy that measures the shadow cost of taxi drivers. This variable measures how long a taxi driver travels with customers on board out of total driving hours. Total travel time with customer on board at a specific day is summed up and then divided by the total time that drivers are on the street. Based on the data received from TLC, there are on average 7,748 taxis on the street at any point during the day. Assuming that this is consistent for all years, the occupancy rate is calculated as a percentage measuring how productive taxi drivers are. Both the denominator and numerator are measured in seconds. The equation deriving the occupancy rate follows:

$$\text{Occupancy rate}_t = \frac{\sum(Dropoff\ time - Pickup\ time)_t\ X\ 100}{7{,}748\ X\ 60\ X\ 60\ X\ 24}$$

4.2.2.4 Average distance per trip

New York Taxi & Limousine Commission (TLC) provides the distance of travel on every trip that occurs in New York. Average distance of travel per taxi trip is calculated by taking the mean value of the distance in miles.

4.2.2.5 Geographic coverage

The taxi trip record data provide the pick-up and drop-off location in terms of longitude and latitude on every trip recorded. The standard deviation of pick-up and drop-off location is used as a proxy measuring the degree of dispersion of pick-up and drop-off.

4.2.3 Control variables

New York City launched a new taxi service named 'Boro taxi' (green taxi) on August 2013 with a purpose of better serving customers hailing taxis outside the area of Manhattan. Green taxis are prohibited to pick-up customers within the Manhattan area where the majority of trips occur. The launch of green taxi would have affected yellow taxi trips, so green taxi's entry is dummified based on the period of its launch to control its effect.

Apart from controlling green taxi, tendency to use taxi as a means of transportation would be closely related to the economic status of individuals. Therefore, quarterly GDP growth rate and monthly population in New York are included as control variables.

Table 2. Definition of variables

Variable	Definition	Source
Independent variable		
Uber Entry	A dummy variable with value =1 since Uber was launched in New York on June 2011	UBER
Dependent variable		
Number of taxi trips	Daily number of taxi trips occurred in New York (1% randomly sampled count data)	TLC
Revenue per driver	Average daily revenue per medallion-licensed driver in dollars	TLC
Occupancy rate	Percentage of occupied taxis in a day as a proxy of shadow cost of drivers	TLC
Distance per trip	Average travel distance per trip in miles	TLC
Geographic coverage	Standard deviation(dispersion) of pick-up and drop-off locations in terms of latitude and longitude	TLC
Control variable		
Green Entry	A dummy variable with value =1 since Green taxi was introduced in New York on August 2013	TLC
GDP growth rate	Quarterly GDP growth rate (%)	OECD
New York population	Monthly New York population in thousands	BLS

4.3 Methodology

The econometric regression model includes variables similar to those used in the empirical strategic management studies. Kosova and Enz (2012) regarded the attack of 9/11 and the financial crisis of 2008 as separate shocks and dummified them in the model to analyze the impact of the two events on U.S hotel performance. Using similar variables to the previous studies, our empirical model of estimation can be written in the general form as below:

$$Y_t = \delta + \alpha\ Shock_{Uber} + \beta\ Shock_{Green} + \gamma\ MktCharact_m + \sum_{s=1}^{q} Y_{t-s} + e_t$$

t indexes the time-series dates from 1 to 2,556 ranging from 01 January 2009 to 31 December 2015. Y_t represents the 5 dependent variables mentioned on the hypothesis chapter; number daily trips, average daily revenue, average trip distance, occupancy rate and geographic coverage. The entry of Uber is viewed as a shock and dummified based on the date when it was launched in New York. As a control variable, the launch of Green taxi in New York, quarterly GDP growth rate and population in New York were added to control such effects.

Several tests were conducted to evaluate the suitability of using our model above. The graphs on the descriptive statistics as well as the Dickey-Fuller test showed that our time series model is stationary. ACF and PACF graphs suggest that autocorrelation exists on our dependent variables, thus 7 days of lag term is added to correct such autocorrelation

effects. To test whether the error term is a white noise, Ljun-Box test was conducted and the test statistics displayed a slight possibility of correlation between the error terms on our time series data. Therefore AR(7) model using OLS as well as ARMA using MLE were both conducted and the BIC suggested that AR(7) using OLS is a better fit to estimate in our model. For the case of number of taxi trips, negative binomial regression and Poisson regression are conducted as it is a discrete count data. Since Poisson distribution assumes that the mean and variance are the same, negative binomial is a more flexible model as it adjusts the variance independently from the mean.

Chapter 5. Empirical Results

5.1 Descriptive statistics

Table 3 describes the summary statistics of the key variables with the data source and Table 4 presents present a separate statistics before and after Uber entered the taxi industry. The t-test verifies that all variables across the split samples are statistically significant at 1%. On contrary to our hypothesis, I found that the number of daily taxi trips increased by 1.98% since Uber entered the market.

For the case of pick-up and drop-off locations, the difference in standard deviation is measured to verify whether the degree of dispersion in pick-up and drop-off locations changed since Uber entered the market. The latitudinal and longitudinal results present a consistent result where the standard deviation for both pick-up and drop-off increased since Uber was introduced in New York. This suggests that taxi trips covered a boarder geographic area of New York since Uber entered the market. The next chapter will provide an empirical analysis that examines the unique effect of Uber through controlling diverse effects that might have affected during the period of the research.

Table 3. Descriptive statistics on key variables

Variable	All observations				Source
	Mean	Std dev.	Min	Max	
Uber entry (dummy)	0.66	0.47	0	1	UBER
Year	2012	1.98	2009	2015	TLC
Daily total taxi trips	4,740.16	670.66	272	8429	TLC
Daily yellow taxi trips	4599.57	697.72	272	8429	TLC
Daily green taxi trips	140.59	221.85	0	824	TLC
Pickup at Manhattan (%)	64.88	3.64	52.17	72.78	TLC
Dropoff at Manhattan (%)	61.02	3.36	49.58	67.24	TLC
Distance (miles)	2.83	3.22	0	26.17	TLC
Travel time (second)	751.98	557.71	0	5880	TLC
Occupancy rate (%)	53.25	9.72	2.24	92.63	TLC
Pickup longitude (°)	-72.62	9.90	-74.13	0	TLC
Pickup latitude (°)	40.01	5.44	0	40.93	TLC
Dropoff longitude (°)	-72.63	9.88	-74.18	0	TLC
Dropoff latitude (°)	40.01	5.43	0	40.96	TLC
Payment option: card (%)	46.25	11.75	14.43	67.64	TLC
NYC population (#)	6,711,554	101,992.30	6,539,927	6,896,730	BLS
GDP growth rate (%)	0.45	0.53	-1.40	1.10	OECD

Table 4. Descriptive statistics on key variables (continued)

Variable	Pre-Uber entry		Post-Uber entry		Mean difference
	Mean	Std. dev	Mean	Std. dev	
Year	2009.77	0.73	2013.16	1.33	+3.39
Uber entry (dummy)	0	0	1	0	+1.00
Daily total taxi trips (#)	4,679.36	752.26	4772.13	621.33	+92.77***
Daily yellow taxi trips (#)	4,679.36	752.26	4557.60	663.65	-121.76***
Daily green taxi trips (#)	0	0	214.53	243.41	+214.53***
Pickups at Manhattan (%)	67.11	1.66	63.71	3.85	-3.40***
Dropoffs at Manhattan (%)	62.99	1.64	59.99	3.57	-3.00***
Distance (miles)	2.72	3.09	2.88	3.29	+0.16***
Travel time (second)	710.98	515.12	773.12	577.31	+62.14***
Occupancy rate (%)	49.70	9.72	55.11	9.20	+5.41***
Pickup longitude (°)	-72.65	9.80	-72.61	9.95	+0.15***[std.]
Pickup latitude (°)	40.02	5.39	40.00	5.46	+0.07***[std.]
Dropoff longitude (°)	-72.58	9.68	-72.60	9.98	+0.30***[std.]
Dropoff latitude (°)	40.04	5.33	40.00	5.48	+0.15***[std.]
Payment option: Card (%)	33.00	7.02	53.22	6.60	+20.22***
NYC population (#)	659,858	2530.27	676,981	7390.06	+17,123***
GDP growth rate (%))	0.28	0.71	0.54	0.39	+0.26***

Note: In the last column, I take the difference between the mean of the variables before and after Uber's entry during our study period. *Significant at 10%, **Significant at 5%, ***Significant at 1%

Figure 1 illustrates the average number of monthly taxi trips by year and it does not seem to have a declining trend since Uber entered the market in mid-2011. Observing the yellow taxis only may lead to an illusion that it slightly dropped in year 2015, however, it is important to consider the fact that green taxis substituted some of the yellow taxi trips in the outer-Manhattan area of New York. For the case of year 2015, green taxi accounts for around 10% of total trips occurred in New York and if I want to measure how the taxis in New York were affected by Uber, it is necessary to include yellow and green taxi trips. Analyzing the yellow taxis only would give an over-estimate and distorted view of Uber's effect as green taxi's effect also needs to be taken into consideration. Figure 2 illustrates the same trend, yellow and green taxis combined, broken down into monthly trips and this figure also suggests that the number of taxi trips fairly remains stable without a declining trend.

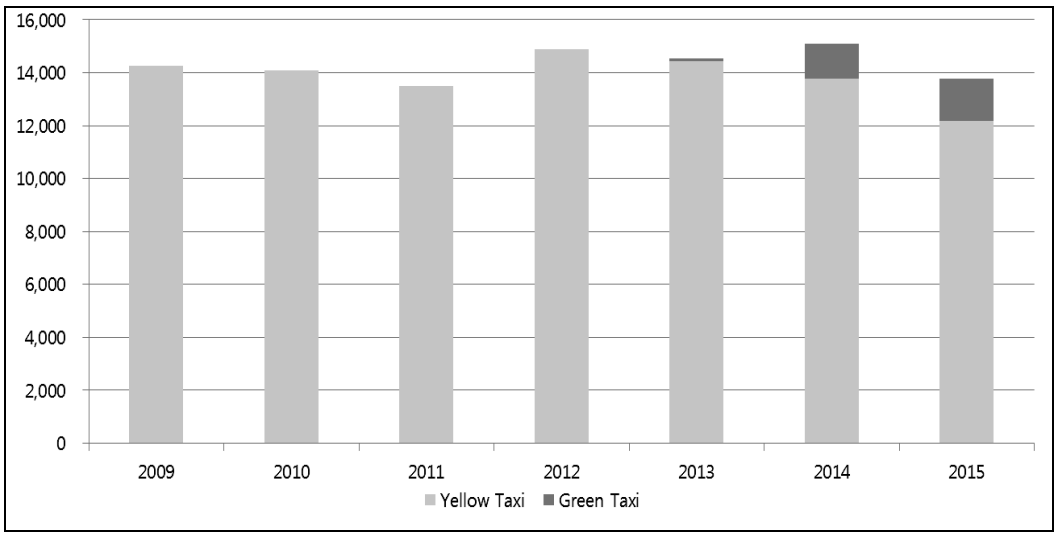

Figure 1. Average number of monthly trips by year (thousands)

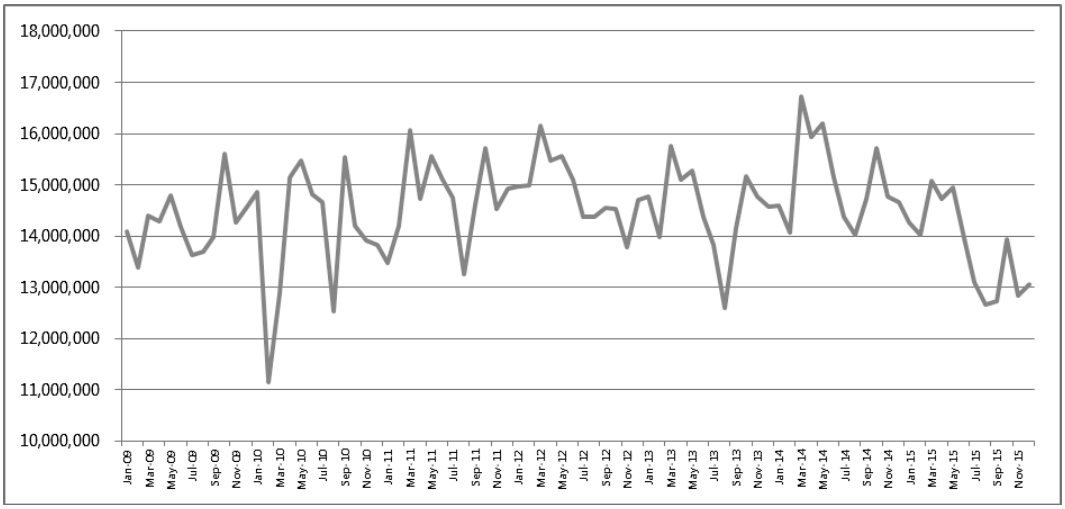

Figure 2. Number of monthly taxi trips

To observe a more direct impact of Uber, I estimated how taxi driver's daily revenue changed across the 7 years of period. I find that the estimated daily revenue per driver has a seasonal trend similarly to the daily number of taxi drips but remain stable across the 7 years of research period.

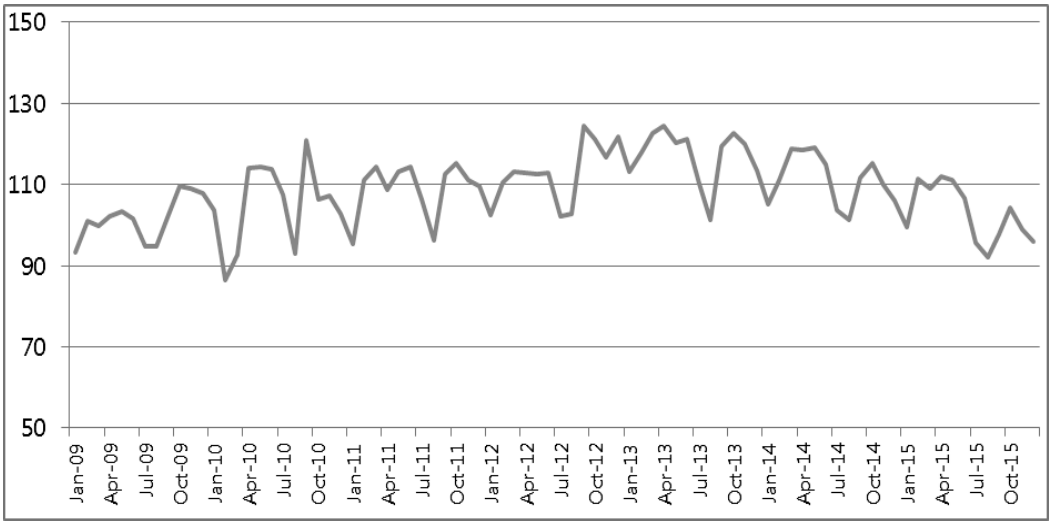

Figure 3. Daily revenue per driver by month ($)

Figure 4 depicts the average trip distance per trip in miles. It clearly shows that a seasonal trend exists with a chasm occurring annually during the month of February and March. Overall, the yearly moving average is in a slightly increasing trend which suggests that taxis traveled to a more wider area of New York. However, the mean difference in average travel distance per trip is only 0.16 miles which might be negligible.

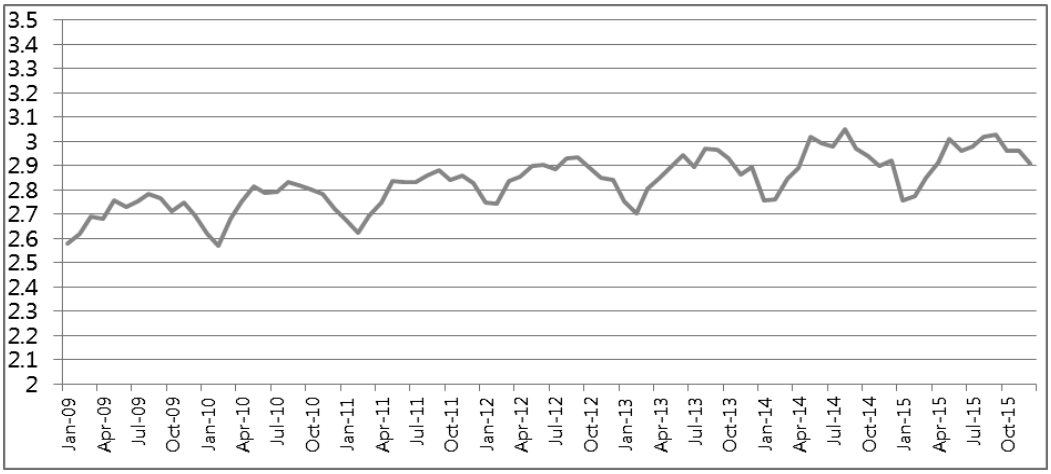

Figure 4. Average trip distance per trip by month (mile)

Similar to the number of monthly taxi trips, there is a high fluctuation in occupancy rate, however, a declining trend is not observed. Rather, the descriptive statistics on table 4 suggests that taxi drivers' productivity actually increased by 5.41% from 49.70 % to 55.11% since Uber entered the market.

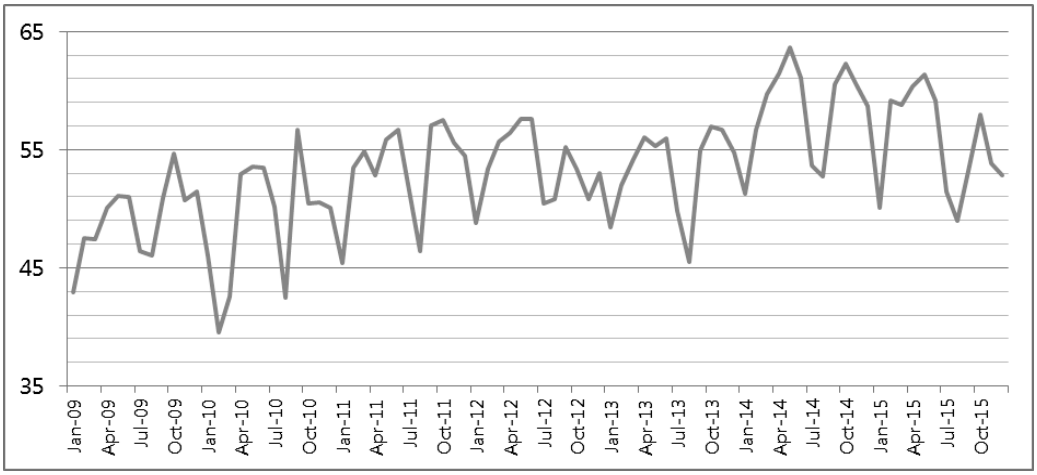

Figure 5. Occupancy rate by month (%)

Figure 6 is a scatter chart comparing the degree of dispersion of pick up and drop- off locations between 2009 and 2015. The x-axis and y-axis each signifies the longitudinal and latitudinal locations of where taxis picked up and dropped off customers in New York. From a randomly sampled 2,000 observations, I plotted each location of pick-up and drop-off as individual dot. All 2,000 samples in year 2009 are yellow taxi and for year 2015, 13.25% (265) green taxis were added to the 2,000 samples which is the same proportion of green taxi trips occurred in 2015. The scatter chart illustrates that the area pick-up and drop-off became more dispersed in 2015 compared to 2009 for both pick-ups and drop-offs. I find a more significant increase in the degree of dispersion in drop-offs than pick-ups which aligns to our descriptive statistics that showed a higher standard deviation increase for drop-offs.

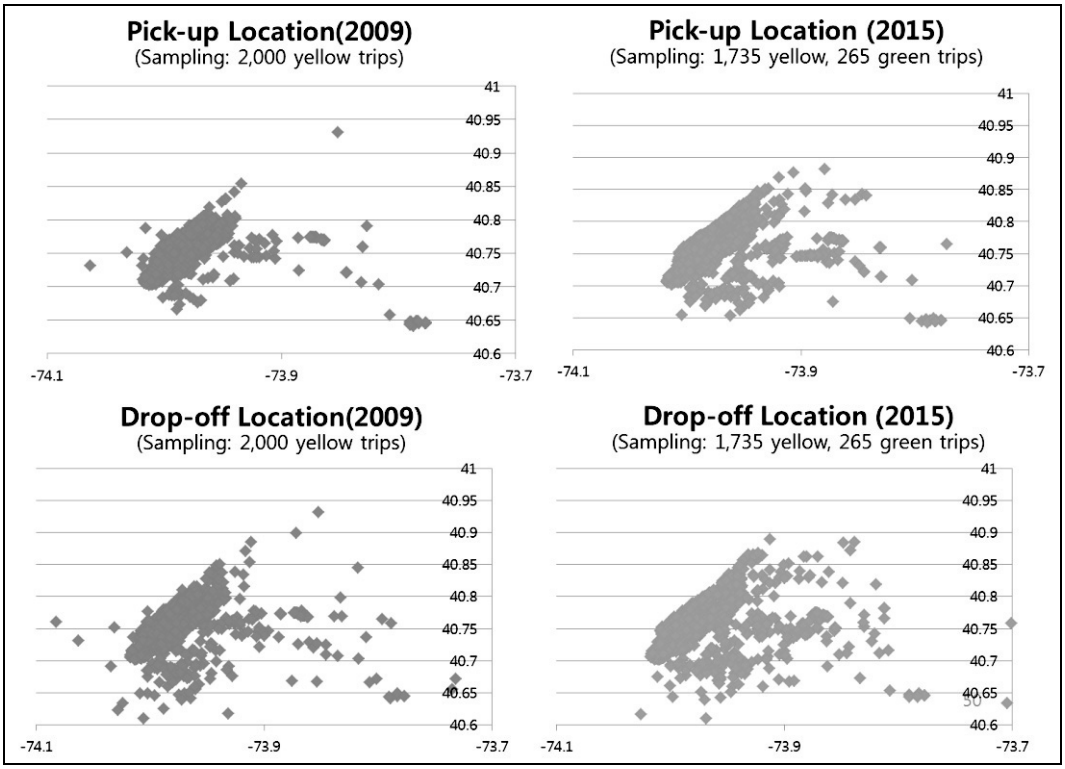

Figure 6. Comparison of pick-up and drop-off locations

5.2 Heat map

In order to visualize the change in the degree of dispersion, heatmap (contour plot diagram) was drawn to compare between year 2009 and 2015. Figure 7 and figure 8 depicts the change in frequencies of pick-ups and drop-offs in the central area of Manhattan in absolute terms. I find that the most frequent pick-ups and drop-offs occurred in the central area of Manhattan near the Time Square. Comparing the number of taxi trips between 2009 and 2015 in absolute scale, the figure illustrates that that the number of pick-ups and drop-offs dropped within the central area of Manhattan as the red and orange area faded out in 2015. However, I also find that there exist some areas where pick-ups and drop-offs increased in the outskirt of Manhattan.

Figure 9 clearly visualizes where the increase or the decrease in pick-up and drop-off occurred within the area of Manhattan. The dark-shaded area represents the area where pick-ups and drop-offs increased and the light-shaded grey area represents the area where pick-ups and drop-offs decreased when I compare between year 2009 and 2015. The area surrounded by a dotted line is the very central area of Manhattan and I find that pick-ups and drop-offs decreased in that area but there exists areas where trips increased outside the central area of Manhattan.

Since such change may be due to the change in absolute number of pick-ups and drop-offs, similar heatmaps are drawn on figure 10 and figure 11 in a relative scale from 0 to 1. The location where it had the highest frequency in pick-up and drop-off is normalized to 1 and other location's value is calculated as a relative scale. The graph shows a similar

result to figure 7 and figure 8, which implies that taxis started to pick up and drop off customers even in the areas where they previously ignored since Uber entered the market.

Figure 12 and figure 13 include the 5 boroughs of New York (Manhattan, Bronx, Queens, Brooklyn and Staten Island) and the enlarged shaded area in the Bronx and Brooklyn suggests that taxis started to cover a wider geographic area of New York.

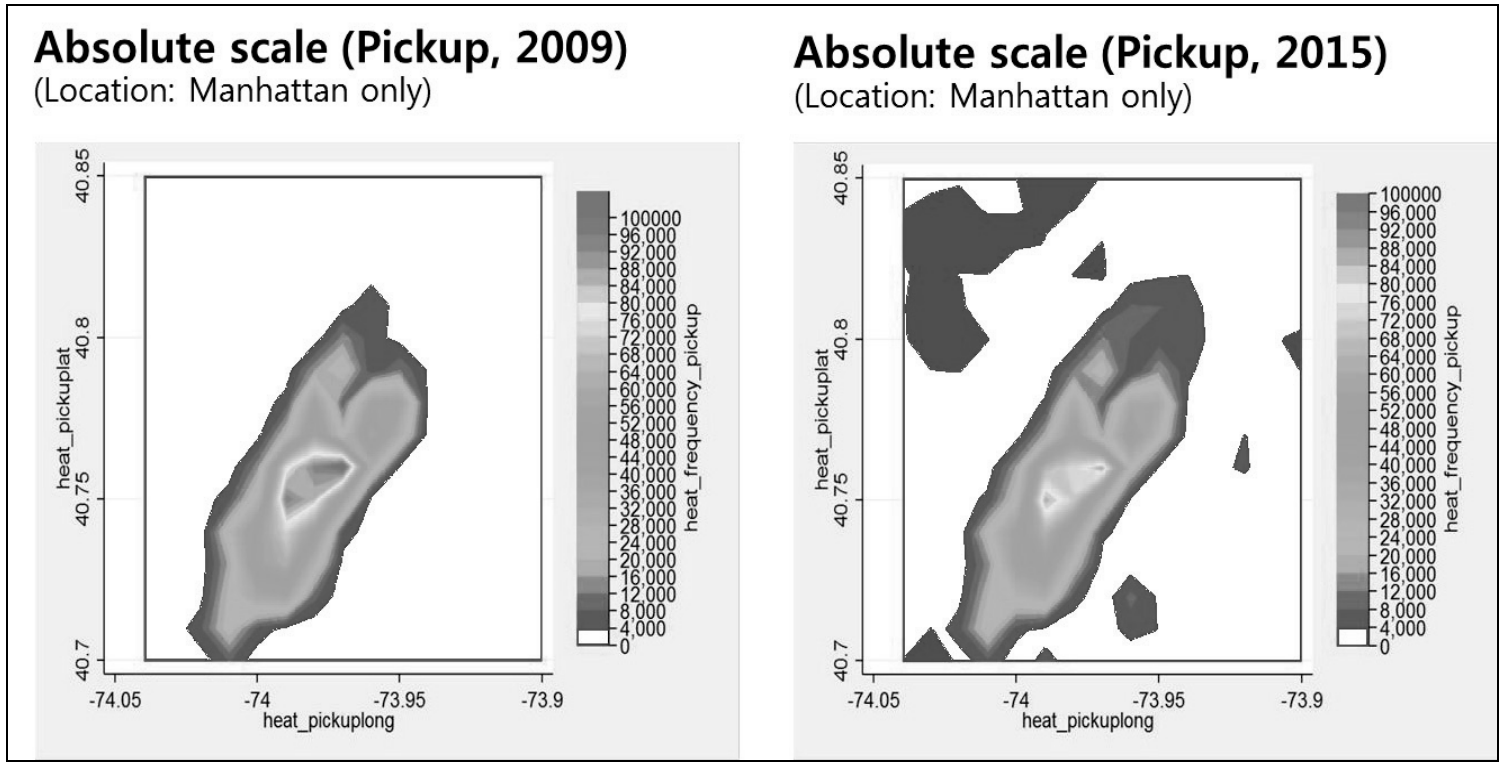

Figure 7. Pick-up location in Manhattan (absolute scale)

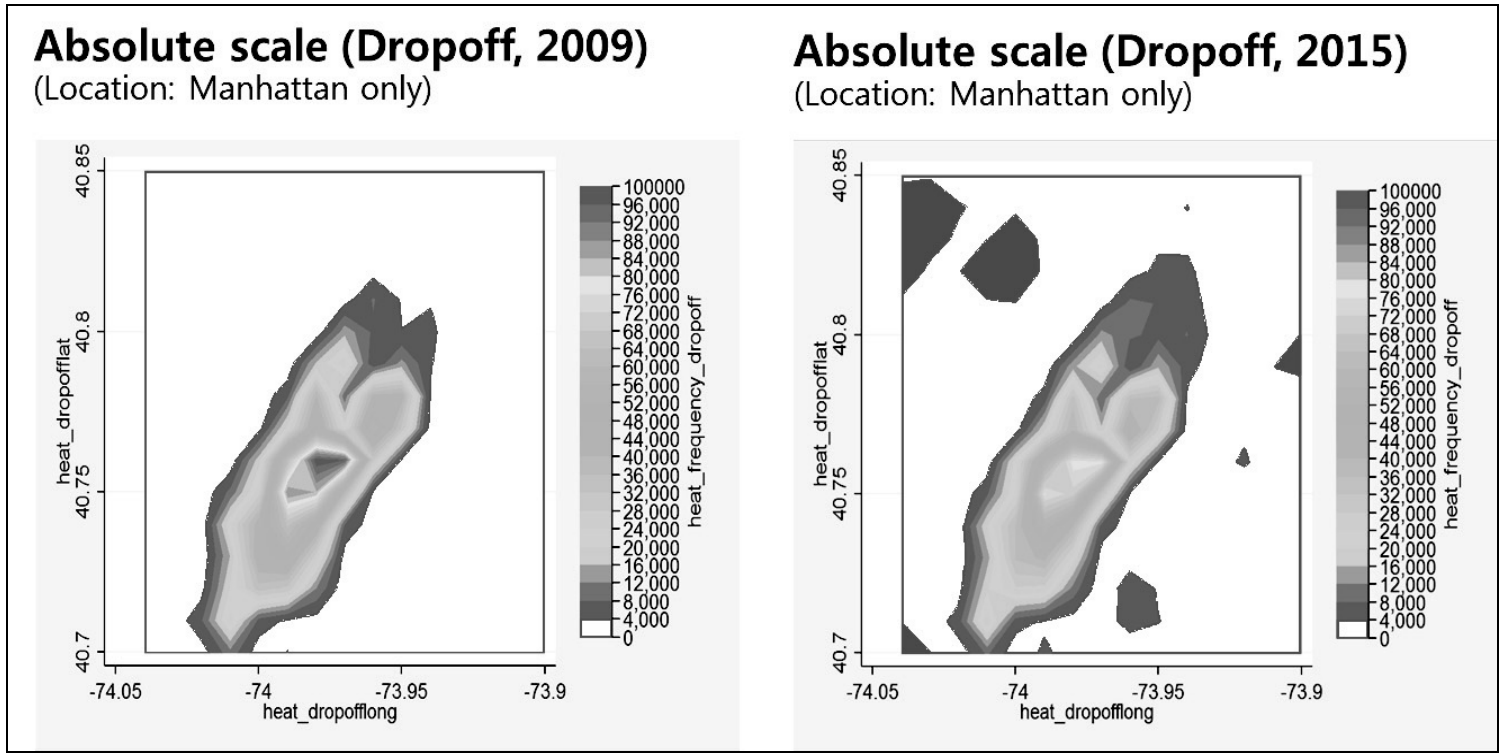

Figure 8. Drop-off location in Manhattan (absolute scale)

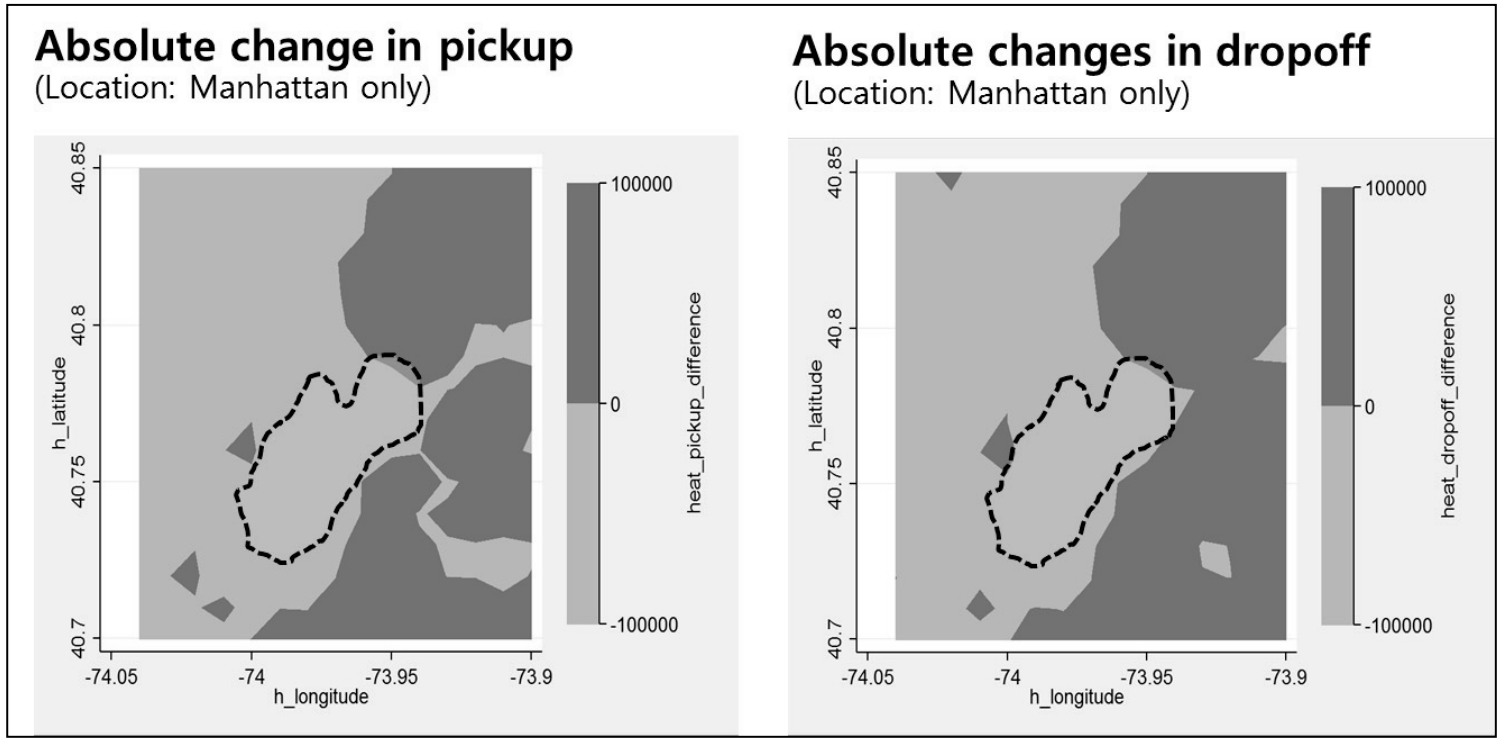

Figure 9. Changes in pick-up and drop-off in Manhattan

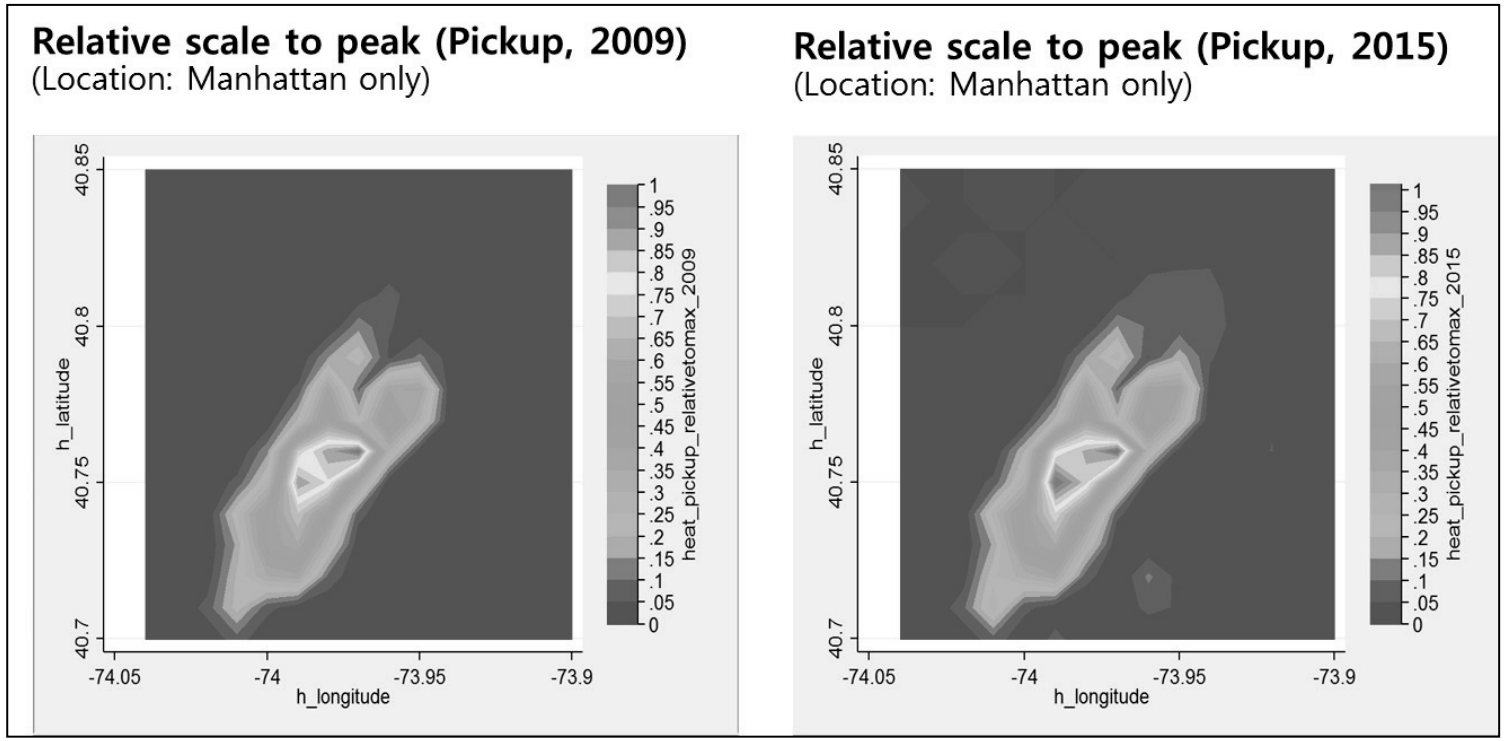

Figure 10. Pick-up location in Manhattan (relative scale)

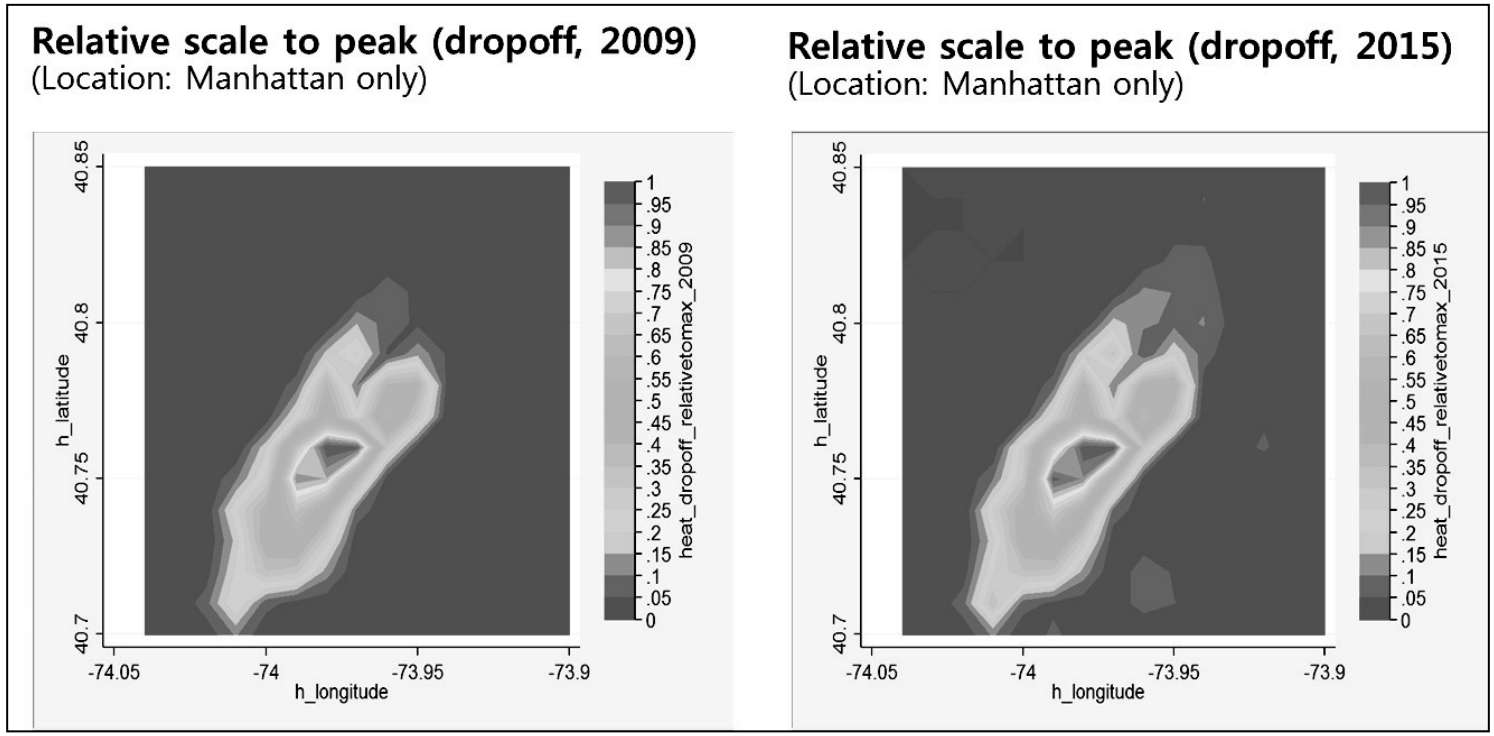

Figure 11. Drop-off location in Manhattan (relative scale)

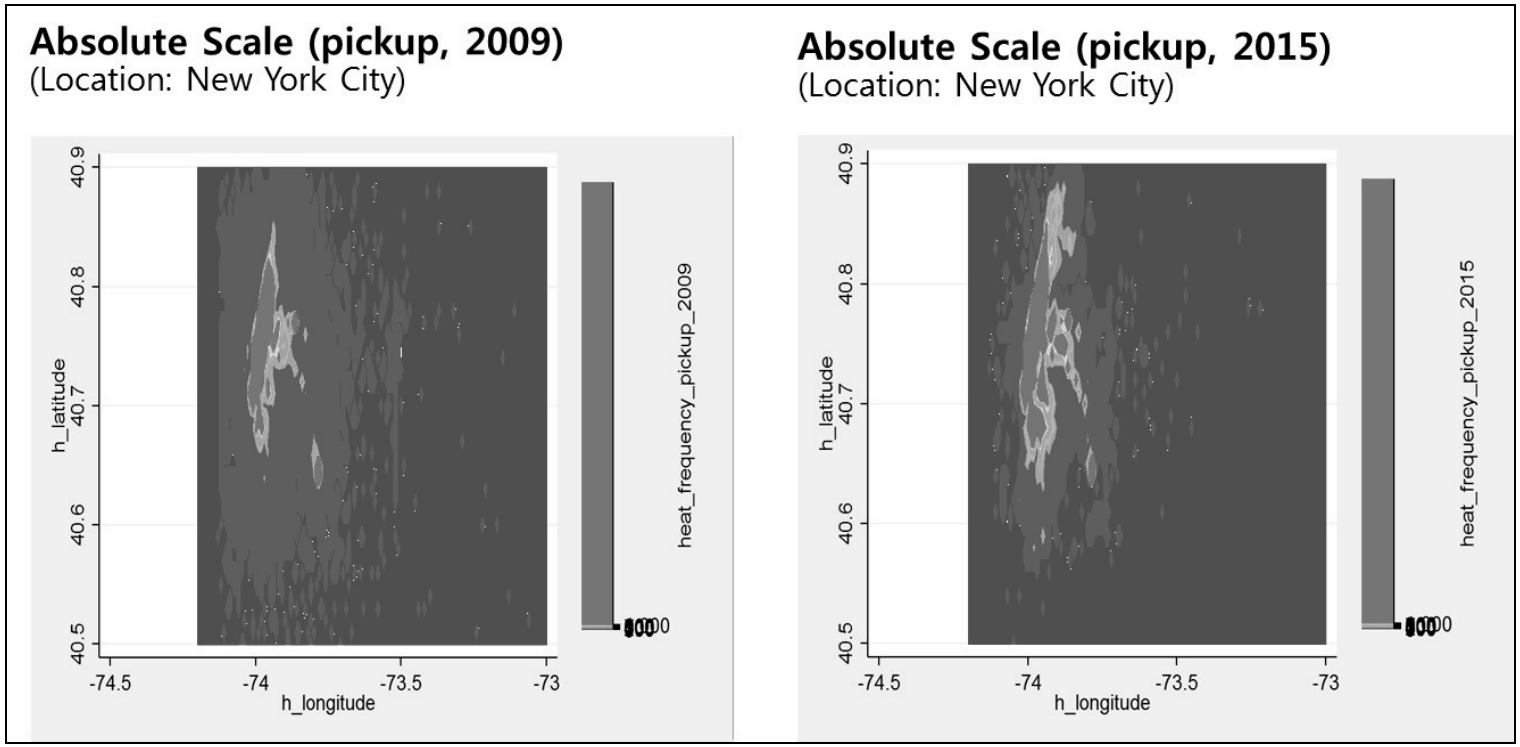

Figure 12. Pick-up location in NYC (absolute scale)

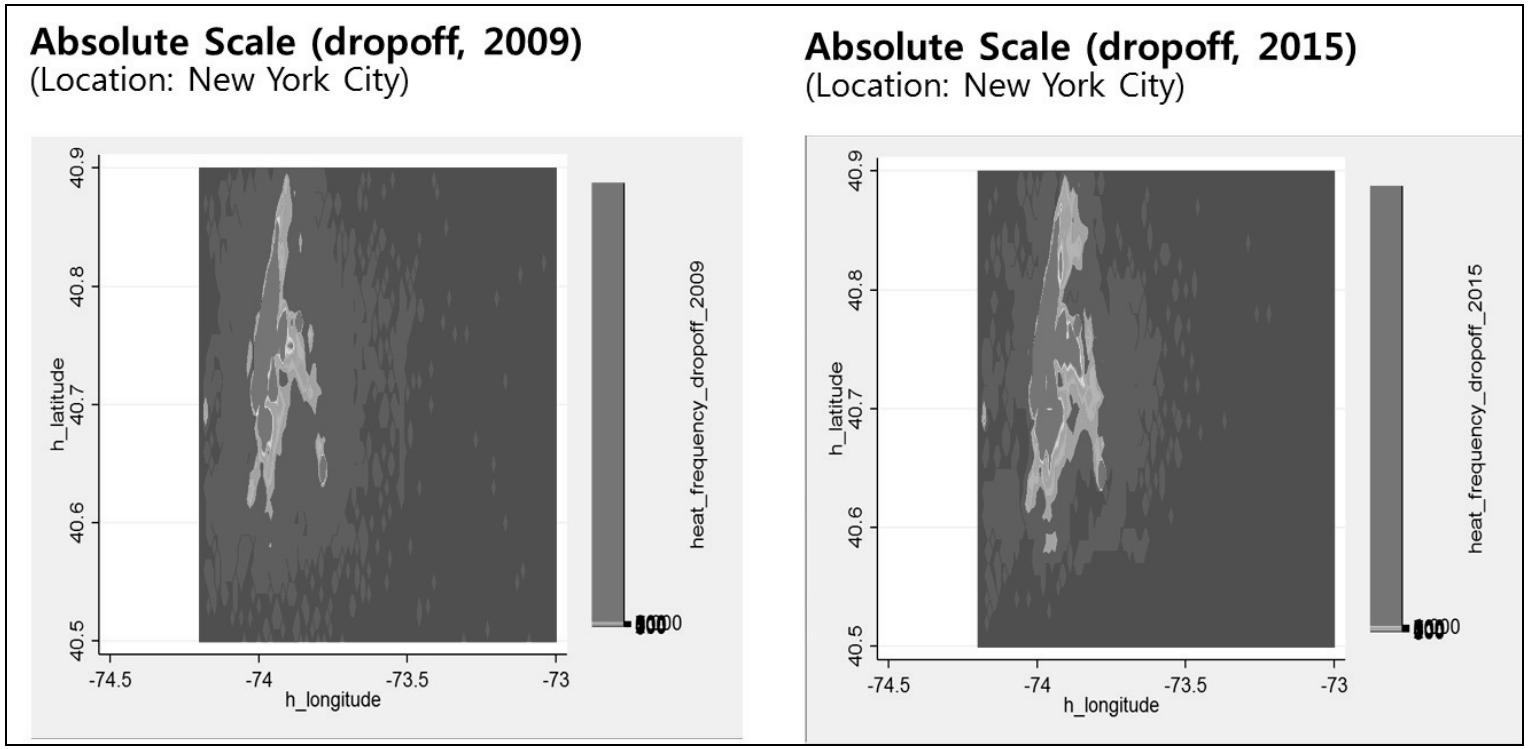

Figure 13. Drop-off location in NYC (absolute scale)

5.2 Estimation results

5.2.1 Number of daily taxi trips

Table 5 presents the estimation result of the number of daily taxi trips using both negative binominal regression (Model 1 and 2) and OLS models (Model 3 and 4). (Result using Poisson regression model is attached on Appendix 1.) Model 1 and Model 3 only includes the Uber entry dummy and Model 2 and Model 4 includes both Uber and Green taxi entry dummies to control the green taxi's effect. The exponential value of Uber entry coefficient implies that taxi trips increased by 1.41% (Model 1) and 1.82% (Model 2) since Uber entered the market. As I randomly sampled 1% of the population data, the OLS result suggests that the number daily trips increased by 6,684 (Model 3) and 8,611 (Model 4) and these values give consistent estimate of 1.41% and 1.82% increase in taxi rides after Uber's entry. Overall, I find a robust result for all OLS, negative binomial and Poisson regression models that that taxi trips did not decrease since Uber's entry.

Table 5. Effect of Uber on daily taxi trips (Negative Binominal, OLS Model)

Dependent variable	Number of daily trips			
	(1)	**(2)**	**(3)**	**(4)**
Uber Entry	0.014 *	0.018 **	66.845 **	86.116 **
	[0.008]	[0.009]	[31.199]	[35.585]
Green Taxi Entry		0.008		44.381
		[0.010]		[39.424]
Constant	7.972 ***	8.276 ***	2934.813 ***	4531.372 ***
	[0.249]	[0.442]	[963.940]	[1714.783]
NY population (000)	0.000	0.000	-0.307 **	-0.548 **
	[0.000]	[0.000]	[0.143]	[0.257]
GDP growth rate	-0.002	-0.003	-3.101	-7.242
	[0.004]	[0.004]	[17.113]	[17.503]
Number of daily trips$_{-1}$	0.000 ***	0.000 ***	0.800 ***	0.799 ***
	[0.000]	[0.000]	[0.020]	[0.020]
Number of daily trips$_{-2}$	0.000 ***	0.000 ***	-0.259 ***	-0.259 ***
	[0.000]	[0.000]	[0.025]	[0.025]
Number of daily trips$_{-3}$	0.000 **	0.000 **	0.068 ***	0.068 ***
	[0.000]	[0.000]	[0.026]	[0.026]
Number of daily trips$_{-4}$	0.000	0.000	-0.031	-0.031
	[0.000]	[0.000]	[0.026]	[0.026]
Number of daily trips$_{-5}$	0.000	0.000	-0.061 **	-0.061 **
	[0.000]	[0.000]	[0.026]	[0.026]
Number of daily trips$_{-6}$	0.000 ***	0.000 ***	0.201 ***	0.201 ***
	[0.000]	[0.000]	[0.025]	[0.025]
Number of daily trips$_{-7}$	0.000 **	0.000 **	0.088 ***	0.088 ***
	[0.000]	[0.000]	[0.020]	[0.020]
Observations	2,549	2549	2549	2549
Pseudo R-Squared	0.042	0.042	0.568	0.568

* Significant at 10%, **significant at 5%, *** significant at 1%

5.2.2 Average daily revenue per taxi driver

Table 6 presents the estimation result of the average daily revenue per taxi driver using OLS model. Model 5 suggests that Uber did not a have direct impact on the taxi driver's earning and Model 6 shows that taxi driver's earning increased by $1.5 since Uber entered the market. On contrary to our hypothesis, I do not find a significant decrease in daily revenue of taxi driver which links to the subsequent question of how taxi drivers maintained their earnings even after Uber diffused into the taxi industry.

5.2.3 Occupancy rate

Table 7 presents the estimation result of the occupancy rate using OLS model. Model 7 suggests that Uber did not a have direct impact on the occupancy rate and Model 8 shows that taxis became more productive by 0.8%. Despite the increase in suppliers in the market due to Uber's entry, I find a paradoxical result that taxi driver's productivity increased at 10% confidence level. This result suggests that incumbent taxi drivers changed their way of doing businesses in order to compete with Uber and retain their market position.

5.2.4 Average distance per taxi trip

Table 8 presents the estimation result of the distance per taxi trip using OLS model. Model 9 suggests that passengers on average travelled 0.015 miles more in distance per trip at 10% confidence level and Model 10 suggests that average distance was not affected by Uber's entry. Since 0.015 miles is very small and thus negligible, I can say Uber did not have a significant impact on the average distance per taxi trip.

5.2.5 Geographic coverage

This result provides the answer on how the incumbent taxis were able to retain their previous level of taxi trips, daily revenue and occupancy rate. Table 9 and table 10 present the regression result of the dispersion of pick-up and drop-off locations in terms of latitude and longitude. The dispersion significantly increased on both pick-up and drop-off locations after Uber entered the market at 5% confidence level and it is robust on both latitudinal and longitudinal locations. This implies that yellow taxis were crowded out to the outer area of Manhattan where most pick-ups and drop-offs occur. In order to retain their market position in the taxi industry, yellow taxi started to travel where it had not been previously served thus leading to a wider geographic coverage.

Table 6. Effect of Uber on revenue per taxi driver (OLS Model)

Dependent variable	**Revenue per driver**	
	(5)	**(6)**
Uber Entry	1.186	1.527 *
	[0.726]	[0.828]
Green Taxi Entry		0.793
		[0.926]
Constant	-11.352	16.771
	[21.822]	[39.408]
NY population (thousands)	0.005	0.000
	[0.003]	[0.006]
GDP growth rate	0.406	0.333
	[0.408]	[0.417]
Revenue per driver$_{-1}$	0.868 ***	0.868 ***
	[0.020]	[0.020]
Revenue per driver$_{-2}$	-0.227 ***	-0.227 ***
	[0.026]	[0.026]
Revenue per driver$_{-3}$	-0.024	-0.024
	[0.026]	[0.026]
Revenue per driver$_{-4}$	-0.040	-0.040
	[0.026]	[0.026]
Revenue per driver$_{-5}$	0.062 **	0.062 **
	[0.026]	[0.026]
Revenue per driver$_{-6}$	0.153 ***	0.153 ***
	[0.026]	[0.026]
Revenue per driver$_{-7}$	0.025	0.025
	[0.020]	[0.020]
Observations	2549	2549
Adjusted R-Squared	0.656	0.656

* Significant at 10%, **significant at 5%, *** significant at 1%

Table 7. Effect of Uber on taxi occupancy rate (OLS Model)

Dependent variable	**Occupancy rate**	
	(7)	**(8)**
Uber Entry	0.557	0.876 **
	[0.363]	[0.416]
Green Taxi Entry		0.736
		[0.466]
Constant	-4.098	21.956
	[10.935]	[19.789]
NY population (thousands)	0.002	-0.002
	[0.002]	[0.003]
GDP growth rate	0.355 *	0.292
	[0.206]	[0.210]
Occupancy rate$_{-1}$	0.807 ***	0.806 ***
	[0.020]	[0.020]
Occupancy rate$_{-2}$	-0.119 ***	-0.119 ***
	[0.025]	[0.025]
Occupancy rate$_{-3}$	-0.001	-0.002
	[0.026]	[0.026]
Occupancy rate$_{-4}$	-0.035	-0.035
	[0.026]	[0.026]
Occupancy rate$_{-5}$	0.062 **	0.062 **
	[0.026]	[0.026]
Occupancy rate$_{-6}$	0.083 ***	0.083 ***
	[0.025]	[0.025]
Occupancy rate$_{-7}$	0.006	0.006
	[0.020]	[0.020]
Observations	2549	2549
Adjusted R-Squared	0.656	0.656

* Significant at 10%, **significant at 5%, *** significant at 1%

Table 8. Effect of Uber on distance per taxi trip (OLS Model)

Dependent variable	**Distance per trip**	
	(9)	**(10)**
Uber Entry	0.015 *	0.017
	[0.009]	[0.010]
Green Taxi Entry		0.003
		[0.011]
Constant	-0.056	0.061
	[0.267]	[0.485]
NY population (thousands)	0.000 ***	0.000
	[0.000]	[0.000]
GDP growth rate	0.021 ***	0.021 ***
	[0.005]	[0.005]]
Distance per trip$_{-1}$	0.176 ***	0.176 ***
	[0.016]	[0.016]
Distance per trip$_{-2}$	-0.054 ***	-0.054 ***
	[0.017]	[0.017]
Distance per trip$_{-3}$	0.046 ***	0.046 ***
	[0.017]	[0.017]
Distance per trip$_{-4}$	-0.018	-0.018
	[0.017]	[0.017]
Distance per trip$_{-5}$	-0.049 ***	-0.049 ***
	[0.017]	[0.017]
Distance per trip$_{-6}$	0.083 ***	0.083 ***
	[0.017]	[0.017]
Distance per trip$_{-7}$	0.566 ***	0.566 ***
	[0.016]	[0.016]
Observations	2549	2549
Adjusted R-Squared	0.554	0.554

* Significant at 10%, **significant at 5%, *** significant at 1%

Table 9. Effect of Uber on pick-up location (OLS Model)

Dependent variable	**Longitude**		**Latitude**	
	(11)	**(12)**	**(13)**	**(14)**
Uber Entry	0.108 **	0.116 **	0.057 **	0.062 **
	[0.051]	[0.056]	[0.028]	[0.031]
Green Taxi Entry		0.022		0.013
		[0.058]		[0.032]
Constant	4.720 ***	5.460 **	2.522 ***	2.965 **
	[1.693]	[2.608]	[0.923]	[1.434]
NY population (000)	-0.001 ***	-0.001 *	0.000 **	0.000 *
	[0.000]	[0.000]	[0.000]	[0.000]
GDP growth rate	0.023	0.021	0.012	0.011
	[0.025]	[0.026]	[0.014]	[0.014]
Longitude/Latitude$_{-1}$	0.283 ***	0.283 ***	0.285 ***	0.284 ***
	[0.020]	[0.020]	[0.020]	[0.020]
Longitude/Latitude$_{-2}$	0.149 ***	0.149 ***	0.149 ***	0.149 ***
	[0.020]	[0.020]	[0.020]	[0.020]
Longitude/Latitude$_{-3}$	0.128 ***	0.128 ***	0.125 ***	0.125 ***
	[0.021]	[0.021]	[0.021]	[0.021]]
Longitude/Latitude$_{-4}$	0.084 ***	0.084 ***	0.085 ***	0.085 ***
	[0.021]	[0.021]	[0.021]	[0.021]
Longitude/Latitude$_{-5}$	0.083 ***	0.083 ***	0.082 ***	0.082 ***
	[0.0211]	[0.021]	[0.021]	[0.021]
Longitude/Latitude$_{-6}$	0.105 ***	0.105 ***	0.104 ***	0.104 ***
	[0.020]	[0.020]	[0.020]	[0.020]
Longitude/Latitude$_{-7}$	0.119 ***	0.119 ***	0.122 ***	0.122 ***
	[0.020]	[0.020]	[0.020]	[0.020]
Observations	2549	2549	2549	2549
Adjusted R-Squared	0.814	0.814	0.810	0.810

* Significant at 10%, **significant at 5%, *** significant at 1%

Table 10. Effect of Uber on drop-off location (OLS Model)

Dependent variable	**Longitude**		**Latitude**	
	(15)	**(16)**	**(17)**	**(18)**
Uber Entry	0.129 **	0.138 **	0.069 **	0.074 **
	[0.053]	[0.058]	[0.029]	[0.032]
Green Taxi Entry		0.022		0.013
		[0.058]		[0.032]
Constant	5.292 ***	6.029 **	2.854 ***	3.285 **
	[1.741]	[2.631]	[0.953]	[1.450]
NY population (000)	-0.001 ***	-0.001 **	0.000 **	0.000 **
	[0.000]	[0.000]	[0.000]	[0.000]
GDP growth rate	0.023	0.021	0.012	0.011
	[0.025]	[0.026]	[0.014]	[0.014]
Longitude/Latitude$_{-1}$	0.271 ***	0.271 ***	0.269 ***	0.269 ***
	[0.020]	[0.020]	[0.020]	[0.020]
Longitude/Latitude$_{-2}$	0.145 ***	0.145 ***	0.146 ***	0.146 ***
	[0.020]	[0.020]	[0.020]	[0.020]
Longitude/Latitude$_{-3}$	0.135 ***	0.135 ***	0.134 ***	0.134 ***
	[0.020]	[0.020]	[0.020]	[0.020]
Longitude/Latitude$_{-4}$	0.090 ***	0.090 ***	0.091 ***	0.091 ***
	[0.021]	[0.021]	[0.021]	[0.021]
Longitude/Latitude$_{-5}$	0.084 ***	0.085***	0.083 ***	0.083 ***
	[0.020]	[0.020]	[0.020]	[0.020]
Longitude/Latitude$_{-6}$	0.104 ***	0.104 ***	0.104 ***	0.104 ***
	[0.020]	[0.020]	[0.020]	[0.020]
Longitude/Latitude$_{-7}$	0.120 ***	0.120 ***	0.120 ***	0.120 ***
	[0.020]	[0.020]	[0.020]	[0.020]
Observations	2549	2549	2549	2549
Adjusted R-Squared	0.818	0.818	0.813	0.813

* Significant at 10%, **significant at 5%, *** significant at 1%

5.3 Key findings

Our results suggest that Uber's disruptive effect was not as detrimental to the incumbent taxis as I hypothesized. I find little evidence that the incumbent taxis were replaced by Uber and we can find how taxis were able to defend themselves against Uber's entry. From the results, incumbent taxis actively responded to Uber's entry by changing their way of doing business. Through enlarging their area of picking up and dropping off customers in New York, taxis actively responded by searching for new market where they had previously ignored and this ultimately led to an augmented consumer surplus. This finding is somewhat different from previous literatures where certain hotel segments were being substituted by Airbnb and CD sales dropped due to P2P file sharing. Why do we find a different result for the case of Uber?

In order to answer the question and to explain how taxi's responses were different from other incumbents, it is important to examine how taxi industry is different from other industries. Unlike most markets where sharing economy is disrupting, taxi industry is a unique type of market where price and the number of suppliers are regulated. Only the medallion-licensed drivers have the legal right to work and drivers cannot arbitrarily change the taxi fare. They have to abide by the rules and regulations set by the government. Most of the incumbents on previous studies responded by altering their price when they faced a new threat of entry and this response strategy was not an option for the case of taxis. Porter's competitive strategies framework suggests the possible ways of competing in a market. In order to maintain a competitive advantage in the market, he

suggests that firms either strategize by lowering down the price to achieve a cost leadership or strategize to provide a differentiated value to customers. Price strategy is seen as a pervasive way of competing and this strategy may be seen as an effective way of gaining competitive advantage depending on the competitive market structure and the firm's position in that market.

However, as it was impossible for taxi drivers to respond by arbitrarily changing the taxi fare, taxi drivers had to find another way of responding to the threats of Uber. Our findings suggest that taxi's response of searching new customers in a new geographic market was effective in defending Uber's entry.

Täuscher (2016) empirically classified digital marketplace business models and found that firms with sharing-economy business model provide distinctive values to the supply and the demand side of the participants. People who are on demand of certain goods or services may find the right match inside the sharing economy platform with a low searching cost. Participants on the supply side can post their idle assets in sharing economy platform where products and services are comparable and this facilitates the transactions. As an example, in Airbnb, the listings posted include various accommodations from a very cheap empty room to luxury castles and those on demand can choose depending on their preference. As such, sharing economy platform provides a wide range of products, services at different prices to customers and it is almost impossible for the affected businesses to gain price leadership while competing with sharing economy. Therefore, as a managerial implication, our result suggests that

responding to sharing economy with price strategy may not be an effective solution. Retaining customers with low price may be effective in short-terms but maintaining its price competitiveness would be almost impossible when the competitor is a sharing economy company. Just like taxis responded to Uber, changing the routines and actively searching for a new market, new customer would be the effective way of defending the treats of sharing economy.

Also, our result shows that customers benefited the most from the entry of Uber. It is true that incumbent taxis had to be more active in order to defend Uber's entry, however, the competition effect clearly created positive values in our society especially for customers. This provides a policy implication that sharing economy can well harmonize with the existing economy and the well-intentioned competition vitalizes the market to be more productive as a whole.

Chapter 6. Conclusion

To summarize the empirical results, I find no direct evidence that the number of neither taxi's daily trip, revenue per driver nor occupancy rate decreased since Uber entered the market. However, a closer look into other dimensions of taxi trip records suggests that Uber crowded out yellow taxis from the central area of Manhattan. Traditional taxis were either forced or voluntarily responded to serve customers outside the Manhattan areas. From enlarging the geographic coverage and serving customers that were previously ignored, taxis were able to retain their previous level of taxi trips and its market share. Even though a precise counterfactual analysis will necessary in the future, without such active responses of searching a new market, taxi drivers would have experience a significant destruction from the entry of Uber.

The fact that average trip distance remains stable but geographic coverage was enlarged implies that taxi drivers changed their business area to a broader area of New York. This implies that destruction somehow occurred from the taxi driver's perspective. However, I could find that drivers actively respond to a new threat of entry by searching for new customers.

While modeling techniques need to be improved, our result suggests that Uber clearly transformed the taxi industry in a positive direction, increasing customer's welfare. The responses of yellow taxis allowed customers to get a better access to taxis even from outside of Manhattan in New York. These findings align with previous literatures that

incumbents do actively respond by creating new market to a new threat of entry for survival.

I can finally conclude that sharing economy and the existing economy can create positive values in our society through well-intentioned competition, complementing each other's weaknesses and strengths. I find that sharing economy is in fact an extension of our existing economy and works as a catfish that vitalize the incumbents to be more productive.

When a new type of disruptive entrant threatens the existing market, there has always been an opposing force that tries to secure its rent. As an example, healthcare providers argue that telemedicine is no substitute for hands on care. However from our studies, I find that incumbents do not merely succumb to the threats but actively respond to acquire a new competitive advantage in the market.

From our study, I find that sharing economy provides a significant benefit to consumers and this aligns with the economic theory that higher intensity of competition leads to consumer surplus. Therefore, raising the entry barrier against sharing economy by enacting regulation is not the answer. With the combination of the incumbents' response, sharing economy do transform the existing market in a welfare-enhancing way.

This paper has several limitations. Even though, I tried to control various effects that might have affected taxi trips, it might still be difficult to attribute the changes to Uber's entry only. As an example, changes in regulations or prices might have affected taxi trips and our model does not fully cover all possible scenarios. Moreover, rather than having

Uber's entry as a dummy, having the access to Uber's trip record data would present a more accurate result on how Uber transformed the existing market.

Among various stakeholders that may have been affected by Uber, this paper examined the existing taxi market only. In reality, Uber would have affected not only the supply-side but also the demand-side. Public transportation, commuters living patterns or those who previously owned a car would have been affected by the introduction of the Uber service. Uber would have transformed diverse parts of the existing market as well as our lives and our paper examined one aspect of it. Examining the comprehensive socio-economic impact of Uber in both supply and demand sides remain as further research.

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Appendix 1: Poisson regression model on Hypothesis 1

Dependent variable	**Number of daily trips**	
	(3)	**(4)**
Uber Entry	0.014 ***	0.017 ***
	[0.001]	[0.001]
Green Taxi Entry		0.007 ***
		[0.001]
Constant	7.967	8.204 ***
	[0.032]	[0.057]
NY population (000)	0.000 ***	0.000 ***
	[0.000]	[0.000]
GDP growth rate	-0.001 *	-0.002 ***
	[0.001]	[0.001]
Number of daily trips$_{-1}$	0.000 ***	0.000 ***
	[0.000]	[0.000]
Number of daily trips$_{-2}$	0.000 ***	0.000 ***
	[0.000]	[0.000]
Number of daily trips$_{-3}$	0.000 ***	0.000 ***
	[0.000]	[0.000]
Number of daily trips$_{-4}$	0.000 ***	0.000 ***
	[0.000]	[0.000]
Number of daily trips$_{-5}$	0.000 ***	0.000 ***
	[0.000]	[0.000]
Number of daily trips$_{-6}$	0.000 ***	0.000 ***
	[0.000]	[0.000]
Number of daily trips$_{-7}$	0.000 ***	0.000 ***
	[0.000]	[0.000]
Observations	2549	2549
Pseudo R-Squared	0.489	0.489

* Significant at 10%, **significant at 5%, *** significant at 1%

Abstract (국문)

공유경제의 확산으로 위협을 받은 기존 기업들은 생존을 위해 어떻게 대응을 해야 하는지를 고민하고 있다. 본 연구에서는 ride-sharing을 대표하는 기업인 Uber가 택시 시장에 들어왔을 때, 기존의 시장에서 어떤 변화가 일어났는지를 실증으로 분석하였다. Uber가 빠르게 확산한 뉴욕의 택시 데이터를 바탕으로 기존 택시의 탑승 건 수, 택시 기사당 일별 매출, 평균 이동 거리 그리고 생산성이 어떻게 변했는지를 분석하였고 그 결과 가설과는 다르게 이들은 크게 감소하지 않는 것으로 확인되었다. 하지만, 택시들의 승하차 지점의 분산도를 확인해본 결과, 택시들이 뉴욕 맨하탄 중심부에서 벗어나 맨하탄 밖의 지역에서도 고객을 태우기 시작한 것을 확인할 수 있었다. 이처럼 택시 기사들은 Uber의 시장탈취 효과를 막고 시장에서의 포지션을 유지하기 위해 해오던 루틴에서 벗어나 적극적으로 대응하였고 이를 통해 택시 업계에서 발생할 수 있는 파괴를 줄일 수 있었다고 보았다. 택시들이 기존에 고려하지 않았던 지역들도 커버하기 시작하면서, 승객들은 뉴욕의 더 넓은 지역에서 택시를 잡을 수 있게 되었고 Uber의 효과가 소비자에게로 전이된 것을 보였다. 공유경제란 파괴적 혁신에 택시들이 적극적으로 새로운 시장을 찾아 나서면서 메기효과가 발생하였다고 볼 수 있다. 따라서 본 연구를 통해 공유경제는 자본주의의 대체재라기 보다는 자본주의의 연장선에서 시장을 더 활성화시키는 것을 확인하였고, 시장에서

이러한 창조적 파괴의 메커니즘이 원활히 발생할 수 있는 정부정책이 필요함을 시사하고 있다.

주요어 : 공유경제, 우버, 창조적 파괴, 파괴적 혁신, 경쟁 효과
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