UBERECONOMY: A STUDY OF TAXIS & TNCs IN REGULATED ECONOMIES

By Sonny Romeo*

Using a difference-in-differences (DID) regression, I examine the effects of Transportation Network Companies (TNCs) on yellow-cab rides, revenues, and distances. I analyze the regulatory environment of the ride-share market in New York City and compare the changes in ridership to that of Chicago. There is evidence that Uber has had a negative impact on the ridership of taxis in both cities.

My analysis examines the period from January 1, 2015, to May 31, 2017, and uses categorical variables to define the effects of regulatory oversight. My treatment effect estimates show that the restriction of worker hours and an increase in regulatory oversight of TNCs has a statistically and economically significant effect on yellow-cabs; with an estimated 28.2% increase in rides per day, and 24% increase in gross fares per day. The magnitude of the treatment effect is, by proxy, indicative of the detriment regulatory reform has on TNCs.

The transportation industry is constantly adapting to bring better service, faster deliveries, and lower costs. The most recent of these evolutions is Transportation Network Companies (TNCs), which operate by connecting riders and drivers through a phone application, the most popular examples being Uber and Lyft. These services have a competitive advantage in the for-hire-vehicle (FHV) industry due to lower costs, friendlier drivers, cleaner vehicles, and an easier payment method (Downes, 2014).

The rise of Uber has led to a material decline in taxi revenues and medallion prices, showing its competitive significance (Bagchi, 2018). It has also caused municipal transportation agencies to re-examine their laws surrounding the ride-share industry (O’Connor, 2015). Since many such agencies are intent upon increasing oversight, I wanted to know how much that oversight burdens TNCs and protects taxis. Thus, I examine yellow cabs as a substitute for TNCs in order to understand the effects of regulation on TNCs and taxis alike. This paper discusses the regulatory environment surrounding yellow-cabs and TNCs, especially in New York City and Chicago.

Uber was launched as a black car company in San Francisco in 2010, by Travis Kalanick and Garrett Camp (Johnson, 2015). The company has fallen prey to criticism from transparency, dynamic pricing, not participating in taxi strikes, unfair competition, driver-on-passenger assault, and internal sexual harassment claims (Siddiqui, 2017; Isaac, 2017). Uber’s competition with the taxi industry has made Uber a target for protest. Marxist economist Richard Wolff has criticized Uber as a company that uses “ruthless competition” to undercut the current regulatory environment (Packman, 2015).

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TNCs have adapted to the regulations placed on yellow-cabs, which have made taxis less competitive. Uber was banned in Spain and Thailand in 2014 for similar alleged unfair competition (Berger, 2018). Even after the release of Curb, a taxi-hailing application meant to mimic TNC appointments, traditional yellow cabs have failed to impress—still offering higher fares than Via and Uberpool in New York City (Kadet, 2017). Despite the advancement in technology, Uber continues to price their rides competitively across America. A study of U.S. fares done by Silverstein (2014), showed that Uber is cheaper in all cities except for New York, and there only when traffic was so bad cars could not go over 20 mph.

The taxi industry rose to popularity in the 1920s and 1930s, while TNCs are as new as 2010. In the 1960s and 1970s, a series of political initiatives led to policies aimed at improving safety for taxi drivers and passengers (O’Connor, 2015). These ordinances and laws are often created to address perceived market failures, but can lead to regulatory capture (Posner, 1975). By enacting restrictions on TNCs, agencies are protecting the yellow-cab business model, rather than allowing technological change to improve consumer welfare.

Uber replaced a common practice of people paying friends to drive them around. By avoiding solicitation, or street-hailing, TNCs sought to dodge the complications of operating a taxi company through online reservations. There is merit in the idea that TNCs can act as an intermediary between customers and freelance drivers without the licensure required for other taxi companies. On the other hand, many regulations are in place to force drivers to certify their viability, and other than the method of hailing a ride, taxis and TNCs perform the same essential service. To settle these concerns, Uber cites its driver rating feature, which allows Uber and its customers to determine the quality of a driver, and drivers to receive incentives for superior service (Burns, 2018). If TNCs are an adaptive reaction to excessive transportation regulation, choices about how to regulate them will certainly affect their evolution.

Though there are parallels, taxis, TNCs, and limousines all operate as different types of services, and thus are regulated differently. Taxis can be hailed by unidentified customers from anywhere along the road, while TNCs use an online reservation. Taxis allow and encourage the use of cash, which provides for more discretion than TNCs which typically charge for services in their application. Finally, taxi companies usually operate locally, while TNCs are international (O’Connor, 2015).

Ride sharing services have not completely evaded regulation, since most municipal governments in the United States require minimum standards for ride-share drivers (O’Connor, 2015). Yet, some cities have been even more aggressive, effectively eliminating TNCs because they refused to follow their standards—such as background and fingerprint checks on employees in Austin, Texas (Macmillan & Silverman, 2016).

New York City imposes a multitude of regulations upon taxi drivers, such as: drivers must hold a chauffer’s license; pass a mental and physical examination; pass background checks and a drug test; submit fingerprints for the record; and complete driver training programs (O’Connor, 2015). Additionally, a taxi driver must have a taxi medallion, which were created in the 1930s to ensure that taxi drivers were not “psychopaths.” This was a novel solution to the problem in an era with limited technology but is now used to limit the number of drivers on the road. In 1937, there were 11,787 taxi medallions issued, which stayed constant until 2004 (Dhar, 2013). Today there are 13,587 taxi medallions in the city, which have plunged in value due to industry disruption by TNCs (Byrne, 2018; Bagchi, 2018). Taxi’s must also be insured at a minimum of $300,000 per occurrence (N.Y.C T.L.C, 2015).
By 2016, the price war escalated as Uber started to lower rates in New York in order to reduce idle driver times (Furfaro, 2016). The New York City Council is currently expanding taxi and TNC regulation to protect the workers’ interests in the price war, which has been linked to increasing suicide rates (Furfaro, 2018). The New York City Taxi & Limousine Commission (TLC) expanded its regulatory oversight into all FHV’s, which includes taxis, limousines, and transportation network providers (TNPs). The TLC today mandates that nearly all the minimum standards covering taxis also cover TNCs, many of which companies like Uber were already compliant with. TLC still controls taxi-cab rates within the city, and they are currently set at $2.50 for entry plus $.50 per mile with additional surcharges (N.Y.C. T.L.C, 2018).

The result of this study is important to understanding the policies surrounding ride sharing. Roads are a common good, because they are non-excludable, but rivalrous, and traffic congestion is the result of a tragedy of the commons. The New York City Council blames Uber for their increased traffic congestion, and as a result is taking regulatory steps to decrease the number of drivers (Berger & Bensinger, 2018). However, without popular services like Uber, customers would have to either take a taxi or drive themselves—which would not help to decrease congestion.

Governments, like the municipal government of New York City, are unsure of how to tackle this problem, and have capped the number of for-hire-vehicles, and demanded drivers be paid a minimum wage while they study the policy effects on the local transportation economy (Berger & Bensinger, 2018; Fitzsimmons, 2018). The New York State government passed the first congestion surcharge on for-hire-vehicles in March 2018. Starting in 2019, rides below 96th Street in New York City will receive an additional surcharge of $2.75 for TNCs, $2.50 for yellow-cabs, and $.75 for pooled-ride-services (Conley, 2018). Via is an example of a pooled-ride-service, which offers a flat fee for picking-up and dropping off passengers a block from their start and end points (Bromwich, 2017).

In contrast, Chicago was one of the earliest municipalities to put TNC regulations into place. The City of Chicago offers two types of TNC licenses, Class A for TNCs with drivers averaging 20 hours of work per driver per week or less, and Class B for TNCs with drivers operating for more. Class A TNCs must have the city’s approval on internal controls and compliance and pay $10,000 for a license to operate in Chicago. Class B TNCs have more strict requirements: drivers for a TNC must obtain a chauffer’s license in the same way as a taxi driver, which requires drivers have 3 years in-state residency or receive training. Additionally, a Class B company must comply with city policy on background checks, drug tests, and vehicle requirements, and pay a higher license fee (O’Connor, 2015). TNCs also must pay a ride-share fee, which increased from its original level of $.52 per trip in 2015 to $.67 per trip at the end of 2017 (Spielman, 2017).

After being driven out of Austin, Texas as a result of similar regulatory reform, in 2016 Uber and Lyft threatened to leave Chicago if the city went through with its proposal to subject drivers to fingerprinting and background checks, incur a $115 driving fee, and forcing TNCs to maintain a larger handicapped-accessible-vehicle fleet (Mukherjee, 2016). Chicago backed off from these regulations and passed a much less restrictive package in June 2016 (Byrne, 2016). This watered-down package allowed TNCs to maintain many of their internal controls, which benefited large TNCs like Uber who were already compliant.

In the period between January 1, 2015 and May 31, 2017, the regulatory environment in Chicago was relatively stable. The licensure requirements and the tax rates were consistent throughout, although there were threats of reform (Byrne, 2016). New York City also maintained
a stable regulatory environment until February 2, 2017, when the Taxi & Limousine Commission limited the number of hours drivers could work each day and week required TNCs to submit trip data for regulatory oversight (N.Y.C. T.L.C., 2017). In the process, TNCs were caught-up in legal liability, such as an error in calculating commission prices by Uber (Wong, 2017). Due to the stable nature of the regulatory environment, I analyze how this change in oversight has affected the rides, quantities, and trip distances for taxis.

To achieve this, I run a difference-in-differences regression on the logarithmic form of: total daily taxi rides, total daily gross taxi fares, and total daily taxi miles, to estimate the treatment effect of increased regulatory oversight of TNCs. Using two categorical variables for the imposition of the regulation and the treated city, I estimate that the treatment effect is a 28.2 percent increase in daily taxi rides, a twenty-four percent increase in daily taxi revenues. The estimated effects are economically significant, because the increase in taxi rides and revenues is indicative of a decrease in output for TNCs. For this reason, transportation agencies should be careful to consider the effects of regulating TNCs because regulation might do more harm than good.

I. Method

Given the wealth of data on taxi rides in New York City and Chicago, I examine the change over time in their relative outputs. Due to the dynamic pricing of taxi services, including government-mandated price controls, I avoid examining how regulations change pricing options, and instead look at how a regulation affecting TNCs affects the number of taxi rides taken, the total distance, and the total revenue.

On February 2, 2017, the TLC in New York City, to maintain public safety, decided to limit the number of hours TNC drivers can work daily and weekly as well as to collect rider data to ensure regulatory compliance (N.Y.C. T.L.C., 2017). The reform requires that drivers work no more than 10 hours in a day with passengers without taking an 8-hour break and that drivers may not work more than 60 hours per week. Additionally, to enforce their rules the TLC requires that all FHV companies share their rider data, much like what was already required for yellow-cabs. A series of compliance issues followed, such as Uber paying back drivers for miscalculating commissions (Wong, 2017). This oversight ultimately led to the TLC imposing taxes and driver caps on TNCs in late 2018 (Berger & Bensinger, 2018; Conley, 2018). During this same period, regulations on TNCs in Chicago remained relatively stable, due to lobbying on the part of Uber.

I hypothesize that in cities that increase regulation of TNCs, the volumes of yellow-cab rides will increase compared to cities that maintain their TNC regulations. This hypothesis assumes that taxi cabs and ride-sharing services are substitutes, and that when new costs are imposed on TNCs, taxis will become more attractive to the marginal consumer. As two of America’s largest cities, Chicago and New York City both have a similar yellow-cab market. The high entry costs and similar regulations make them comparable. In both cities, taxi medallion prices are negatively correlated with variables indicating increased use of TNCs (Bagchi, 2018). While both cities have pressured TNCs with regulation, neither have yet to force them out.

To examine this hypothesis, I look at the data between January 1, 2015, and May 31, 2017, and estimate the effects of New York City’s regulations by employing the difference-in-differences model, with data from New York City and Chicago before and after New York City enacted legislation to regulate the number of hours drivers are allowed to work and required
TNCs to turn over trip level data. The change in taxi rides and revenues over the period represents a stable regulatory environment, with minimal reform passed. After the selected period, New York City became far more stringent on TNC requirements. As part of my hypothesis, I expect that, following the reform, relative to the change in Chicago, the New York City taxis perform better.

The classic difference-in-differences model is categorized by the expression:

\[
\log (y_{it}) = \alpha + \beta r_t + \lambda n_i + \delta r_t n_i + \epsilon_{it}
\]

Where \(y\) is the dependent variable (rides, revenue ($), and distances (mi)); \(i\) indexes the cross-section of cities and \(t\) is an index of the time; \(r\) is a categorical variable that is equal to 1 after the regulations go into place and 0 beforehand; and \(n\) is a categorical variable equal to 1 for New York City and 0 for Chicago. The coefficient \(\alpha\) is the intercept; \(\beta\) is the coefficient on the difference in \(y\) before and after regulatory change; \(\lambda\) is the coefficient on the difference in \(y\) between New York City and Chicago; and \(\delta\) is the difference-in-differences estimator, which is interpreted as the treatment effect of the policy.

Running this regression on all three variables gives an estimate of the effect of adding regulations to TNCs on each variable. This gives a basis from which to draw on the overall effects of TNC regulations on the transportation economy. If the rise in costs for TNPs impedes the network’s growth, then the trend in yellow-cab variables will increase. However, there will be bias from the difference in volume, due to a significantly larger population and for-hire-vehicle market in New York City. Thus, I calculate the coefficients for the log of the target variables. A semi-log regression on the left-hand side variable means that for a 1 unit increase in the right-hand side variable, the percent change in \(y\) is equal to one-hundred multiplied by the coefficient.

II. Data

A series of TLC releases in the city of New York makes the municipality the most well documented in taxicab data, and thus can be used for treatment. Additionally, the Department of Business Affairs & Consumer Protection in Chicago has released taxi trip data from 2013 to 2017. I examine the range between January 1, 2015, to May 31, 2017, because prior to this period, the regulatory environment in both cities began to change, as the TLC claimed authority over TNCs, and Chicago started to regulate the companies. The range I examine represents a period where regulations were stable, aside from the regulation indicator.

The Chicago dataset I analyze consists of 5,651,114 taxi rides in the city of Chicago from January 1, 2015 to May 31, 2017. The City of Chicago, with the help of the Chicago Department of Business Affairs & Consumer Protection (BACP), collects taxi ride data through two payment processors believed to cover most taxis in Chicago. This dataset has a lot in common with the New York City taxi ridership dataset, as they both include several points of reference for fare amounts and trip distance. For my analysis, I look to the daily count of rides, sum of revenues, and sum of distances. This dataset is expressed below in Figure 1.
The dataset I use for New York comes from the City of New York’s Taxi & Limousine Commission (TLC) yellow taxi data. The TLC gets this data from technology providers authorized under the Taxicab & Livery Passenger Enhancement Programs (TPEP/LPEP). Unlike the dataset for Chicago, these datasets include several million rides each month. The NYC TLC has released yellow taxi trip data from January 2009 to June 2018. Since the second half of 2018’s data is unavailable at this time, a comparative analysis on the effects of capping drivers in New York is unavailable (Berger & Bensinger, 2018). Over the same 2015-2017 period I use for Chicago, New York City has data on 326,599,921 rides.

Figure 2 shows a significant visible difference in the data for the total distance. In the dataset for Chicago, the distance maintained a constant level between the number of rides and the total revenues, which is expected since the trip distance is a factor used in calculating the fare price. In the New York City dataset, there are several distance outliers and there is not a clear trend along those data. Given the difference in the overall trend of the distance data between New York City and Chicago, a difference-in-differences regression along this variable will likely not be significant.
To account for the variation in the sum of daily distances, Figure 3 shows the rides and revenues in New York City absent the distances. These variables give a more comparable view in the differences between New York City and Chicago. The daily revenues and rides in both cities are closely correlated, while distances are not for New York City.

**FIGURE 3: Daily New York City Rides and Revenues.**

For comparison I look at the differences between the variables in each city. First, to further my point on the variance in distances in New York City, I show in Figure 4 the differences in the sum of daily distances variable between the two cities. Due to exogenous factors, such as population size, I show the variables on two axes—which gives a better visual representation of the semi-log regressions I run on these variables.

**FIGURE 4: Daily Sum of Total Distances Comparison**

In Figure 4, the distances in New York City show that the changes in over-time are not consistent with the trend of the data in Chicago. Given the that parallel trend assumption is necessary for validity in a difference-in-differences analysis, this variable is less significant than revenues and rides. Figures 5 and 6 tell a different story. These figures show that the variables trend more closely, suggesting that the factors that affect yellow-cab revenues and total rides industry wide are reflected in the data. The parallel trends along both variables give more
significance to their difference-in-differences regression. Notably, the graph appears to show separation around the end of 2016 and beginning of 2017, which includes the date of policy change in New York.

### III. Analysis

Using these data, I take the log of each variable and run them through the difference-in-differences regression model; where “Regulation Indicator” is the dummy variable equal to 0 before February 2, 2017, and 1 after; “NYC Indicator” is the dummy variable equal to 1 for New York City and 0 for Chicago; and “Treatment Effect” is the estimate of the difference-in-differences between New York City and Chicago before and after the regulation. Table 1 shows the results:
The difference-in-differences estimator for rides and revenues is positive, and the estimator on distances is negative. The p-values on the estimator for distances is .0364, showing a downward trend change in taxi distances up to the ninety-six percent confidence level. The p-values on the other estimator values are both significant at the ninety-nine percent confidence level. Since the DID coefficient for revenue and rides are qualitatively and quantitatively more significant than the DID coefficient for distances, I focus my analysis more on the former variables. The DID coefficients are expressed as the estimated percent change in the variable divided by 100, due to the semi-log nature of the regression. The estimate for rides, revenues, and distances are 28.2 percent, 24 percent, and -18.9 percent, respectively.

Bagchi (2018) shows, using taxi medallion prices and Google Trend data on keywords relating to Uber and Taxi, that there is a negative correlation between TNC virility and the value of Taxi medallions. The datasets I use are to analyze how TNC regulation affects the output quantities of yellow-cabs. The figures show observable changes in the differences in revenues and rides before and after the regulations go into place. The distance data has visible outliers, which likely effected the uncertainty on the difference-in-difference estimator (DID) for

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Table 1: Difference-in-Differences Regression on Rides, Revenues, and Distances

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>log(Rides)</th>
<th>log(Revenue)</th>
<th>log(Distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulation Indicator</td>
<td>-0.411***</td>
<td>-0.367***</td>
<td>-0.419***</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.023)</td>
<td>(0.064)</td>
</tr>
<tr>
<td>NYC Indicator</td>
<td>4.053***</td>
<td>4.106***</td>
<td>4.450***</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.033)</td>
</tr>
<tr>
<td>Treatment Effect</td>
<td>0.282***</td>
<td>0.240***</td>
<td>-0.189**</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.032)</td>
<td>(0.090)</td>
</tr>
<tr>
<td>Constant</td>
<td>8.774***</td>
<td>11.505***</td>
<td>9.925***</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.023)</td>
</tr>
</tbody>
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Observations: 1,764
R^2: 0.987
Adjusted R^2: 0.987
Residual Std. Error: 0.234 (df = 1760)
F Statistic: 45,155.150*** (df = 3; 1760)

Note: *p<0.1; **p<0.05; ***p<0.01
distance. The variance in the distance data is likely the cause of an error in processing the data, as originally several of the values were negative and others were unreasonably large. As such, I focus my analysis on the verifiable ride and revenue data.

The regression on revenues and rides gives statistically significant measures on the DID. On the number of rides, the ninety-five percent confidence interval on the DID shows between a 21.795 percent and a 34.572 percent increase in taxi rides after the New York City TLC began to limit the number of hours worked by TNC drivers. Additionally, the DID on revenues estimates between a 17.733 percent and a 30.302 percent increase in yellow-cab revenues after the regulation was put into place. I can say with confidence that the regulations in New York City have had a positive impact on the revenues and number of rides for yellow-cabs. However, the fact remains that the ninety-five percent confidence interval on distances is between a -36.609 percent and a -1.195 percent increase.

IV. Conclusion

Uber, and TNCs generally, have been under immense regulatory pressure since their entrance into the transportation market. More recently, policies have been implemented to limit the number of drivers on the road in New York City, such as capping the number of drivers on the road (Berger & Bensinger, 2018). Through my analysis, I show that the policies related to limiting working hours and requiring more regulatory oversight are beneficial to the incumbent yellow-cab firms, which were previously regulated and do not incur a cost from the new regulations on TNCs.

With the costly regulatory process that is on-going, I firmly believe that continuing to regulate TNCs with taxes and driver limits will continue to increase the rides and revenues of yellow-cabs. As the costs to TNCs increase, the traditional taxi becomes more appealing to consumers. While this may be one of the goals of regulation, the competitive advantage of TNCs came from both their regulatory environment but more importantly their technology. By decentralizing the traditional ride-share system and allowing drivers to dictate their own schedules, TNCs more easily connected drivers and passengers.

Moreover, the overall decline in yellow-cab demand following increasing TNC popularity, shown in Bagchi (2018), indicates that TNCs are offering more value for their prices. The increased competition means that in order for traditional taxis to survive, they must adapt to a more technologically advanced model. However, by regulating and limiting TNCs, municipalities protect yellow cabs from competition, and yellow cabs will not have to bear the full weight of the regulatory burden. A continuation of these policies will instead burden consumers and prolong the life of the traditional yellow-cab.

REFERENCES