Ridehailing Service Equity in Normal and Rare Conditions

Mobility21 Project ID #350

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FINAL RESEARCH REPORT

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Problem Statement

The stated goal of the Mobility21 Big Idea project for "Ridehailing Service Equity in Normal and Rare Conditions" was to "investigate the economic and equity impacts of ride-hailing services like Uber and Lyft under normal and rare conditions, along with public policies that may enhance benefits and mitigate private and social costs and equities."

Approach and Methods

We proposed to research this topic by:

1. Econometric estimation of Uber and Lyft effects on US cities: We leverage the staggered entry of Uber and Lyft across metro areas to isolate changes caused by TNCs from other changes happening in those cities. We use statistical methods including difference in differences for this.
2. Evaluation of demographic and geographic patterns of ride-hailing use: We evaluate changes in TNC ridership in high and low-income neighborhoods in response to disruptive events, including heat waves and COVID-19, by statistically comparing changes across these neighborhood groups.
3. Qualitative research with stakeholders: We interview TNC riders and drivers to understand their perceptions and views.
4. Simulation and optimization: We simulate TNC fleets responding to policy price signals to understand the degree to which market failures are distorting TNC operations and whether policy intervention is justified on economic efficiency grounds.

Findings, Conclusions and Recommendations

We summarize findings, conclusions and recommendati ons from each of the relevant studies by organizing them into four sections:

1. Effects of Uber and Lyft entry on U.S. cities
2. Traffic implications of Uber and Lyft
3. Environmental implications of Uber and Lyft
4. Equity implications of Uber and Lyft

Section 1: Effects of Uber and Lyft Entry on U.S. Cities

This section addresses the questions:

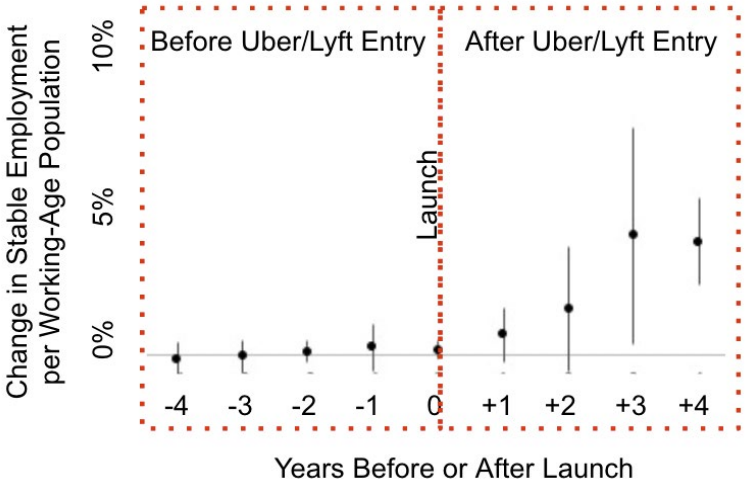
- How have Uber and Lyft affected car ownership and transit use in U.S. cities?
- How have Uber and Lyft affected employment, wages and economic growth in U.S. cities?

How have Uber and Lyft affected U.S. cities?

Studies : We conducted several statistical analysis studies leveraging the staggered entry timing of Uber and Lyft across U.S. cities as a natural experiment to isolate the effects caused by Uber and Lyft from other factors

Finding : Uber/Lyft entry has **increased vehicle ownership** on average across cities, especially in **car-dependent** and **slow-growth** cities.[1]

Finding : Uber/ Lyft entry has **displaced transit** most in cities with **high income** and high **childless household** rates.[5]



Finding : Uber and Lyft entry has **increased economic growth, employment, and wages of unstable jobs** .[2]

Implications : Uber/ Lyft have contributed to employment, wages, and economic growth in U.S. cities, particularly in industries marked by high turnover or job instability.

The overall effect on car ownership and transit depends on the type of city.

[1] Ward, J., J.J. Michalek, C. Samaras, I. Azevedo, A. Henao, C. Rames, T. Wenzel (2021) "The impact of Uber and Lyft on vehicle ownership, fuel economy & transit across U.S. cities," *iScience* v21 n1 p101933.

[2] Koling, A., D. Armanios, C. Forsythe, A. Jha, and J. Michalek (2022) "Ride-sharing the wealth: effects of Uber and Lyft on jobs, wages and economic growth" working paper, Carnegie Mellon University.

Section 2: Traffic Implications of Uber and Lyft

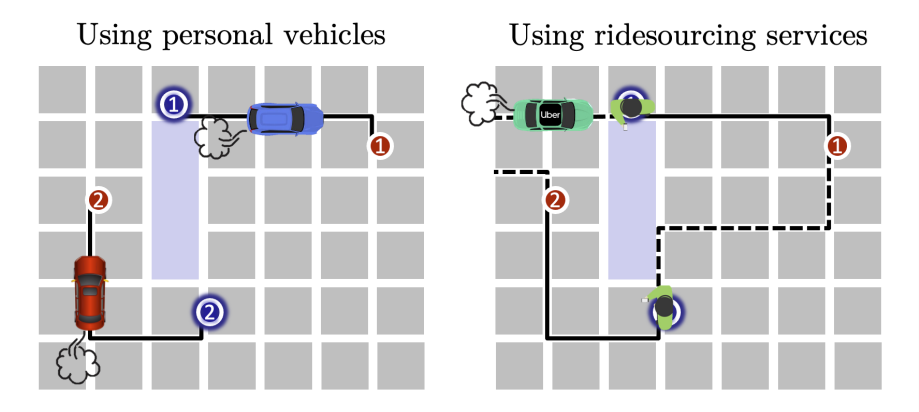
This section addresses the questions:

- What costs do Uber and Lyft trips impose on cities?
- Should Uber and Lyft pool more rides?
- Do city TNC congestion policies work?

What costs do Uber and Lyft trips impose on cities?

Study : We simulate Uber/Lyft rides and personal vehicle trips, estimating the external cost to society of congestion, crash risk, air pollution, and greenhouse gas emissions.[3]

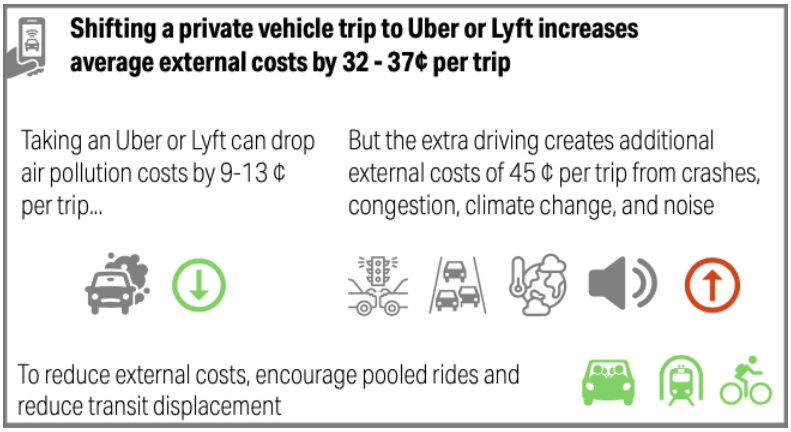
Finding : Compared to driving a personal vehicle, **Uber and Lyft clean the air but clog the streets** .



An Uber or Lyft ride can **reduce air pollution** damages by 9- 13¢ per trip by avoiding the number of times vehicles produce bursts of pollution when starting up. But the extra TNC driving to and from passengers **increases costs from congestion, crash risk, climate change and noise** by 45¢.

Overall, an average **Uber/Lyft ride creates more external costs to society than a personal vehicle trip** .

Implications : Policies that encourage TNC use over personal vehicle use are not likely to increase net benefits to society.



To reduce the external costs of TNC use for society, cities can **encourage pooled rides over solo rides** , **encourage enhanced safety** in TNC vehicles, and **discourage transit displacement** .

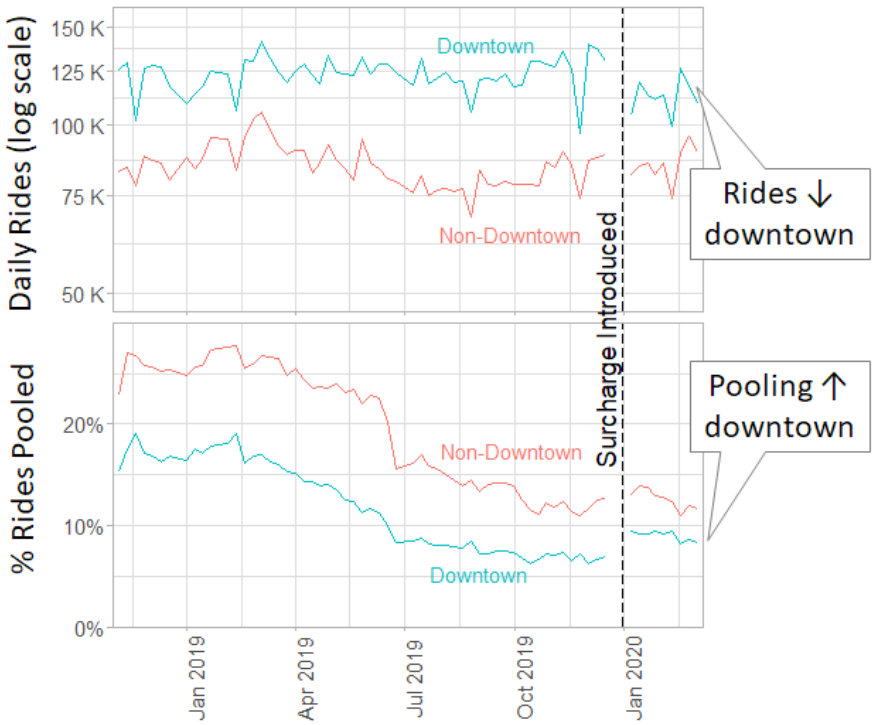
In the next two pages we address whether city TNC policies work and how much cities should encourage pooled rides.

[3] Ward, J., J.J. Michalek and C. Samaras (2021) "Air pollution, greenhouse gas, and traffic externality benefits and costs of shifting private vehicle travel to ridesourcing services," *Environmental Science & Technology*, 55 19 13174-13185.

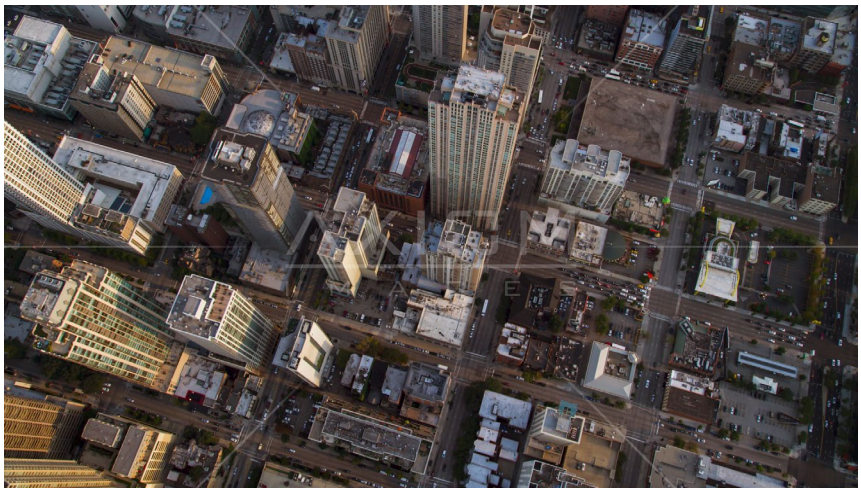
Do city TNC congestion policies work?

Context : In January 2020, the City of Chicag o implemented a tax to encourage Uber and Lyft riders to pool rides and discourage travel to and from downtown and special zones during peak hours.

Study : We conducted a statistical analysis to identify the effect of Chicago's policy on peak downtown rid es relative to other rides.[4]



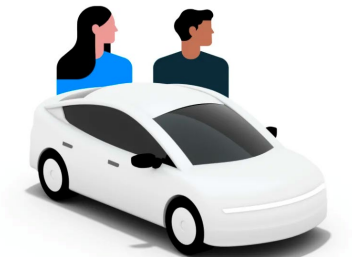
Finding : Chicago's policy **had its intended effect** , resulting in an estimated **3% increase in pooling rates** and an **8% reduction in total rides to and from downtown during peak hours** .



Implications : City tax policies can **successfully and meaningfully influence TNC ridership behavior** .

[4] Bruchon, M., C. Forsythe, C. Andreasen, K. Whitefoot and J. Michalek (2022) "Does congestion pricing for Uber and Lyft work? Effects of Chicago's downtown zone surcharge," working paper, Carnegie Mellon University.

Should Uber and Lyft pool more rides?

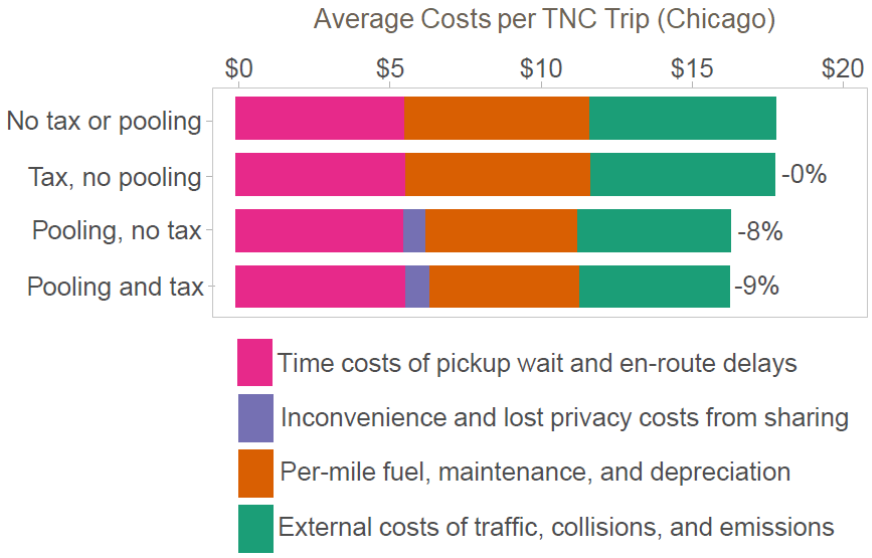


Study : We optimize a fleet of TNC vehicles to satisfy ride demand in Chicago, using public TNC travel data, and we compare results when optimizing the fleet for minimum private costs versus minimum social costs, including external costs to society of congestion, collisions and emissions.[5]

Finding : Ride pooling reduces external costs of congestion, collisions and emissions by 18% and reduces overall social costs by 8%.

Private costs alone appear to provide most of the needed incentive for TNCs to pool rides.

When charged for the costs of congestion, collisions and emissions imposed on others, our TNC fleet increased pooling rates by only 3% and reduced social costs by 1% (~$5M per year in Chicago).



Implication : Ride pooling is an important mechanism for reducing social costs of ridesourcing services, but private costs alone appear to provide most of the incentives needed for TNCs to pool rides at nearly the socially optimal level. **There is limited room for policy intervention to increase net benefits to society by encouraging ride pooling** beyond that which TNCs already have incentives to provide.

However, disincentives beyond cost (such as forecasting and operational challenges) may discourage pooling, and **other policy justifications (such as equitable service coverage) may still warrant policies** to encourage pooling.

[5] Bruchon, M., C. Forsythe and J.J. Michalek (2022) "Should ridesourcing services pool more?" working paper, Carnegie Mellon University.

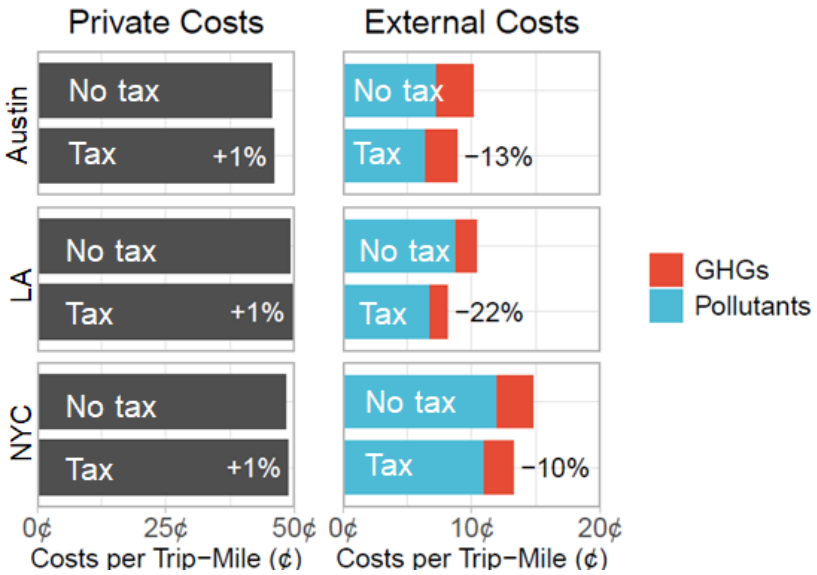
Section 3: Environmental Implications of Uber and Lyft

This section addresses the question:

- Should Uber and Lyft electrify more cars?

Should Uber and Lyft electrify more cars?

Study : We optimize a fleet of TNC vehicles to serve demand in Chicago with a mix of conventional gasoline vehicles, hybrid electric vehicles, and plug-in electric vehicles. We compare results when (1) minimizing the private costs of serving rides versus (2) mini mizing social costs, including cost to society of air pollution and greenhouse gas emissions.[6]



Finding : When faced with the **costs that air pollution and greenhouse gas emissions** impose on others, **cost-minimizing TNCs electrify more of their fleet** , reducing air emission costs by amounts that range from 10% (in New York) to 22% (in Los Angeles; ~$29M per year).

Implications : Policy interventions to encourage electrification of TNC fleets, such as California's Clean Miles Standard, may be warranted on social welfare grounds.

However, in most cases the socially optimal fleet involves **a mix of vehicle powertrain technologies** – not 100% electric vehicles – so policies should **avoid overly blunt instru ments** and allow flexibility for gasoline vehicles to be used in portions of the fleet, such as for vehicles that serve only peak demand.

[6] Bruchon, M., I. Azevedo and J.J. Michalek (2021) "Effects of air emission externalities on optimal ridesourcing fleet electrification and operations," *Environmental Science & Technology*, v55 n5 p3188-3200.

Even gasoline Uber/Lyft vehicles can reduce air pollution compared to personal cars, but most of the costs to society from TNCs come from congestion and crash risk, so **electrifying Uber and Lyft will not alone solve the TNC externality problem**.[7]

[7] Ward, J., J.J. Michalek and C. Samaras (2021) "Air pollution, greenhouse gas, and traffic externality benefits and costs of shifting private vehicle travel to ridesourcing services," *Environmental Science & Technology*, 55 19 13174-13185.

Section 4: Equity Implications of Uber and Lyft

This section addresses the questions:

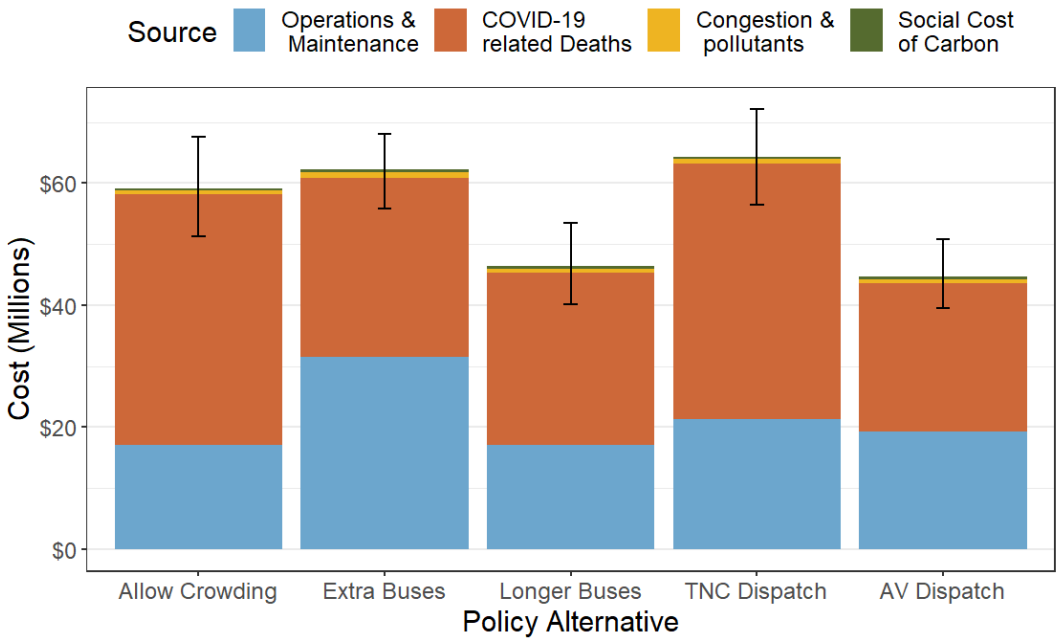
- What is the role for TNCs in a pandemic?
- How did COVID-19 affect TNC ridership in high- and low-income neighborhoods?
- How did heat waves affect TNC ridership in high- and low-income neighborhoods?

What is the role for TNCs in a pandemic?

Study : We estimate the risk of contracting COVID -19 on the Pittsburgh bus system during the pandemic and compare options for mitigating risk.[8]

Findings : We estimate that 4% of COVID-19 cases in the early months of the pandemic could have been contracted on the bus or from a bus rider. The most cost-effective mitigation approaches with estimated benefits that outweigh costs include (1) **dispatching longer buses** to maintain reduced passenger density and (2) **dispatching on -demand autonomous TNC vehicles** for over-capacity riders.

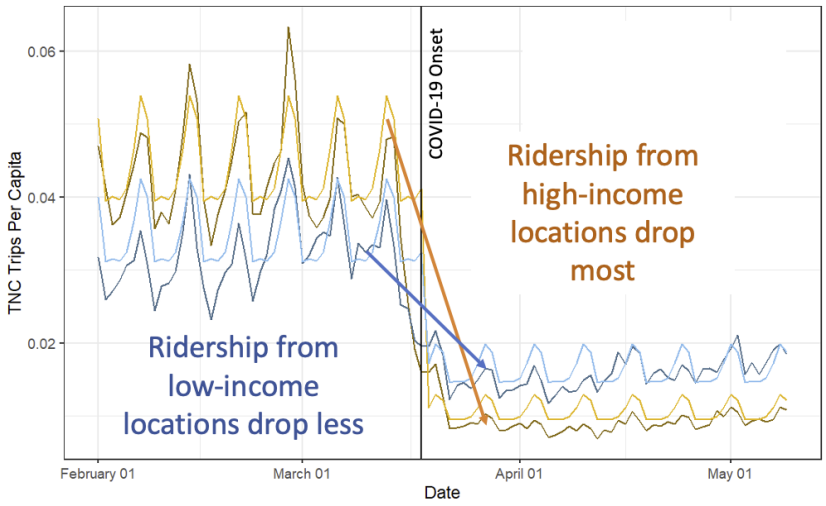
Implications : Implementing longer buses on high demand routes is a strategy that can be implemented today by transit agencies to increase bus capacity and reduce viral spread. Autonomous TNC vehicles can be dispatched in future scenarios to supplement overcapacity bus routes in pandemic scenarios. This type of policy can benefit essential workers who are often from low-income or minority groups.



[8] Hanig, L., C. Harper and D. Nock (2022) "COVID-19 public transit precautions: trade-offs between risk reduction and costs," Working Paper, Carnegie Mellon University.

How did COVID-19 affect TNC ridership in high- and low-income neighborhoods?

Study: We study the change in TNC ridership after the 2020 onset of the COVID-19 pandemic in both low- and high-income neighborhoods in Chicago.[9]



Findings: We find a **larger drop in ridership among riders traveling from high-income neighborhoods** than among riders traveling from low-income neighborhoods.

Implications: **Low-income travelers** appear more likely to be essential workers or otherwise be **dependent on TNC rides** and unable to adjust travel behavior in response to the pandemic, highlighting inequities. Some essential riders may perceive the health risk during the COVID pandemic on TNCs as lower than other public transit modes.

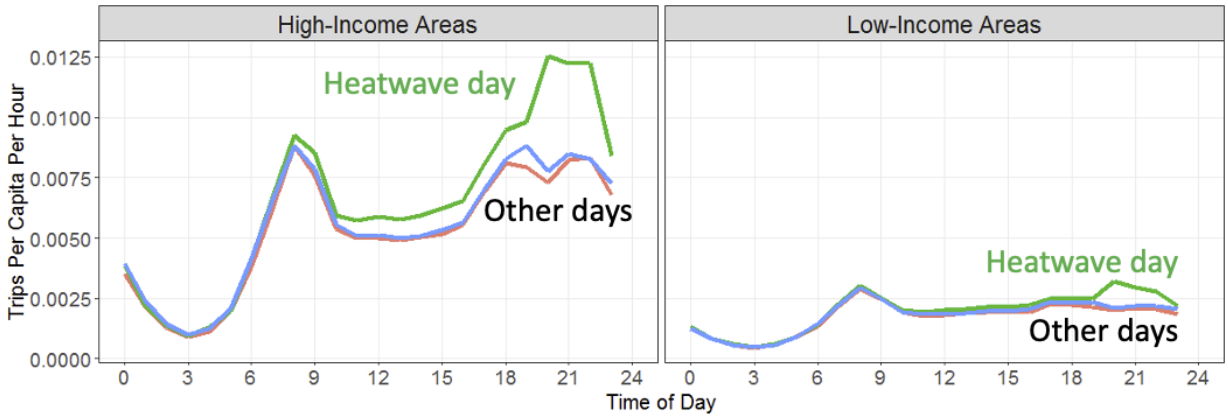
Recommendations: Conduct surveys to **better understand why travelers from low-income neighborhoods use Uber and Lyft** over alternatives and whether changes in transit may be warranted to support these travelers. **Evaluate perception of the relative safety of different transportation modes**.

[9] Hanig, L. D. Nock, C. Harper (2022) "How did COVID-19 affect TNC ridership in high- and low-income neighborhoods?" Working Paper, Carnegie Mellon University

How did heat waves affect TNC ridership in high- and low-income neighborhoods?

Study: We study the change in TNC ridership during heatwaves in both low- and high-income neighborhoods in New York City in July 2019.[10]

Findings: We find that the rate of **increase in the number of trips during heat waves** is **higher in high-income neighborhoods** than in low-income neighborhoods.



Implications: **High-income travelers** appear to have a greater **ability to switch to more comfortable modes** during heat waves, while low-income riders are more likely to endure extreme temperatures and humidity while waiting at and walking to or from public transit stops.

Recommendations: Transportation planners should consider viability of special service offerings in low-income neighborhoods and those with less transit access during heat waves to alleviate transit disparity exacerbated by extreme weather.

[10] Gebresselassie, M., J.J. Michalek, D. Nock, C. Harper (2022) "Impact of Heatwave on TNC-Usage Rate in Low-and High Income Neighborhoods in New York City" Working Paper, Carnegie Mellon University.

Publications

Publications from this research include the following. Starred working papers were submitted to the Transportation Research Board of the National Academies Annual Meeting.

1. Bruchon, M., I. Azevedo and J.J. Michalek (2021) "Effects of air emission externalities on optimal ridesourcing fleet electrification and operations," Environmental Science & Technology, v55 n5 p3188-3200.
2. Bruchon, M., C. Forsythe, C. Andreasen, K. Whitefoot and J. Michalek (2022) "Does congestion pricing for Uber and Lyft work? Effects of Chicago's downtown zone surcharge," Working paper, Carnegie Mellon University.*
3. Bruchon, M., C. Forsythe and J.J. Michalek (2022) "Should ridesourcing services pool more?" Working paper, Carnegie Mellon University.*
4. Gebresselassie, M., J.J. Michalek, D. Nock, C. Harper (2022) "Impact of heat waves on TNC-usage rates in low-and high income neighborhoods in New York City," Working Paper, Carnegie Mellon University.
5. Hanig, L. D. Nock, C. Harper (2022) "How did COVID-19 affect TNC ridership in high- and low-income neighborhoods?" Working Paper, Carnegie Mellon University
6. Hanig, L., C. Harper and D. Nock (2022) "COVID-19 public transit precautions: trade-offs between risk reduction and costs," Working Paper, Carnegie Mellon University.
7. Koling, A., D. Armanios, J. Michalek, C. Forsythe and A. Jha (2022) "Ride-sharing the wealth: Effects of Uber and Lyft on jobs, wages and economic growth" Working paper, Carnegie Mellon University.*

Data

As described in the data management plan, non-proprietary data and code will be made publicly available as supplemental information along side each published papers on the associated journal's website as the working papers above are published in academic journals.