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Title: Tensions and complementarities in mass transit and ride-hailing decisions through a survey-based randomization

Abstract: The rapid rise of ride-hailing services, such as Uber and Lyft, has raised concerns about potential impacts to ridership of public transit systems. If ride-hailing reduces mass transit use, then implications for energy use and emissions could be devastating. On the other hand, ride hailing can complement mass transit by serving as a first/last mile connector to mass transit stations. The increased flexibility ride-hailing provides also serves as an effective emergency backup to mass transit use, potentially making the use of mass transit more appealing to those with a strong aversion to unexpected delays. Given these diverging scenarios, it is crucial to understand the tensions and complementarities between ride-hailing and more energy-efficient travel modes. This is even more pressing given the possibility of lower ride-hailing prices in the future due to vehicle automation, for example, which will amplify any existing impacts of ride-hailing on travel behavior. In this study, we use data from the WholeTraveler Transportation Behavior Study survey to analyze the impact of ride-hailing price changes by randomly assigning participants to three different hypothetical ride-hailing prices ($1.20/mile, $0.70/mile and $0.20/mile). For each individual, we present an estimate of the cost of travel via ride-hailing to their reported primary destination using this hypothetical per-mile price, and ask them to select the mode(s) they would use on a typical commute day given that price, allowing for multimodal trips. We find significant non-linearities in the impact of ride-hailing prices on mass transit use. When prices drop sharply to $0.20/mile, participants are more likely to completely substitute away from mass transit in favor of ride-hailing, whereas with a more moderate ride-hailing price drop to $0.70/mile, participants demonstrate an increased likelihood of using mass transit on average. These findings at $0.70/mile vary heterogeneously in a non-linear way by distance from residence to the nearest mass transit stations and by total distance from residence to primary destination. Our results suggest that the impact of ride-hailing on mass transit is likely to be nuanced. Moderately more affordable ride-hailing may well complement and enable increased mass-transit use, especially for those with long commutes, by facilitating first/last mile transit access. However, for those for whom this linkage benefit is lower, or if ride-hailing becomes much more affordable relative to alternatives, then ride-hailing is likely to cannibalize mass transit ridership.