The contribution of new mobility technologies and services to climate change mitigation and economic welfare

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Outline

1- Motivation, Background and Objective
2- Results of the analysis
3- Conclusion and next steps
Motivation,
Background and
Objective
In order to limit global warming to 1.5 degrees Celsius until the end of the century, and avoid catastrophic climate change, the world must attain zero GHG emissions around 2050, that is, “reach carbon neutrality”, while having negative emissions from 2050 onwards. (IPCC, 2018)
Transportation is a difficult sector to decarbonize

Options:

- Renewable fuels (e.g.: hydrogen, biofuels)
- More efficient technologies (e.g.: electric vehicles)
- More sustainable mobility (e.g.: public transportation, active modes)
- Behavioral changes
Behavioral changes: actions from the demand side to induce change in transportation consumption

- Shifting from ownership to service consumption
- Matching capacity to use
Technologies and services to promote that

- Carsharing
- Ride-hailing
- Autonomous vehicles
Objective

Analyze the current literature on new mobility technologies and services to assess how they may contribute to changes in vehicle use and ownership, as well as adoption of alternative services, with the consequent impacts in terms of energy use, its associated emissions, transportation decisions, and overall economic welfare of the population.
Results of the analysis
Overall, direction of effects is fairly the same across studies, but their magnitude is influenced by assumptions made.
<table>
<thead>
<tr>
<th>Vehicle Ownership</th>
<th>VKT/VMT</th>
<th>CO₂ emissions</th>
<th>Other transit modes</th>
<th>Economic welfare</th>
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<tbody>
<tr>
<td><strong>Carsharing</strong></td>
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<tr>
<td>Lower vehicle ownership across studies (range: 3 – 80% reduction)</td>
<td>Lower VKT/VMT across studies (range: 2 – 83% reduction)</td>
<td>Lower emissions across studies (range: 4 – 67% reduction)</td>
<td>Increases public transit and active modes’ use</td>
<td>Increases welfare: more access to households, fills mobility gaps, cheaper than vehicle ownership</td>
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<td><strong>Ride-hailing</strong></td>
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<td>Inconclusive, but there is a negative trend among users (either reduced car ownership or intention to shed a vehicle)</td>
<td>Higher VKT/VMT across studies (range: 8 – 157% increase), mostly due to deadheading</td>
<td>Lower emissions, which are mostly due to the modelling of shared/pooled services and EVs across studies</td>
<td>Mostly substitutes modes. Results across studies: - Public transit: 17 – 31% - Public transit and active modes: 34 – 58% - Private cars and taxis: 19 – 83%</td>
<td>Increases utility for users and grants positive externalities, but also increases congestion and reduces traffic speed, which may negatively impact welfare</td>
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<td><strong>Autonomous vehicles</strong></td>
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<td>Not much studied. Some papers show that shared autonomous vehicles (SAVs) decrease ownership</td>
<td>Higher VKT/VMT across studies (range: 2 – 47% increase). SAVs mitigate impacts</td>
<td>Lower emissions across studies (range: 3 – 87% reduction) when performance is optimized, increased fuel efficiency, etc.</td>
<td>Substitute public transit and active modes</td>
<td>Increase welfare for users and reduce system’s operating costs. May increase congestion, but impact is mitigated with SAVs</td>
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Carsharing

- Impacts vary across studies due to several factors: region; density; built environment; public transit accessibility; and carsharing service and business model

- Overall, carsharing leads to:
  - Reduced vehicle ownership
  - Reduced vehicle kilometers traveled (VKT)/vehicle miles traveled (VMT)
  - Reduced emissions

- Fuel efficiency is improved if the carsharing fleet is comprised of energy efficient vehicles

- Interaction with other transit modes: impacts are mixed and depend on type of carsharing service

- Finally, carsharing is providing utility to customers
Ride-hailing

- Mostly substitutes other transit modes and increase VKT/VMT, especially due to deadheading
- Energy impacts are not ideal, but welfare impacts are:
  - In Brazil, used as an alternative to unsafe transportation modes
  - In Cape Town, counters for insufficient mobility services
  - In São Paulo, positively impact accessibility of workers in the job market
- Therefore, the design of an effective sustainable transportation system must account not only for its energy impacts, but also for the benefits it brings to society
Autonomous vehicles

Benefits:

• Provide mobility to underserved populations (the disabled, elderly, and children)
• Reduce the opportunity cost of travelling (multitasking on board)
• Improve security and efficiency of travel
• Reduce overall number of vehicles and parking spaces
• Lead to population clustering in urban areas

Drawbacks:

• Increase VKT/VMT, energy use and emissions
• Contribute to urban sprawl, job displacement and unemployment

Overall, impacts are still unclear: benefits at the vehicle level may be offset by greater vehicle utilization and shifts in travel patterns at the society level
Conclusion
Conclusion

- Impacts of new mobility technologies and services on energy consumption and emissions have been fairly studied.
- While the promotion of these services may be policy driven, there is no approach, however, that considers the two perspectives of energy use and economic welfare.
- By impacting the welfare of agents, new mobility technologies and services that are employed as policy solutions to improve energy consumption may further affect productivity and the economy.
- Such outcomes have yet to be measured and are under development by the authors.
NEXT STEPS:
The contribution of new mobility technologies and services to climate change mitigation and economic welfare in Rio de Janeiro state, Brazil

Use OSeMOSYS to develop a model of Rio de Janeiro’s energy system

Model new mobility technologies and services into OSeMOSYS

Develop a general equilibrium model and link it to the energy system/mobility model to assess welfare implications

Propose policy solutions to achieve different outcomes

TENTATIVE SCHEDULE

- Fall 2020
- Spring 2021
- Fall 2021
- Spring 2022
Thank you!

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