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Cost-based Analysis of Autonomous Vehicle Services

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Hypotheses

Hypothesis 1:

Current transport modes will not be cost-competitive in the age of AVs

Hypothesis 2:

It will be unattractive to own automated vehicles for private customers

Costs for AV-Services

Shared AVs (*per trip kilometre)*

- Burns et al. (2013): 0.09 CHF (US)
- Fagnant and Kockelman (2015): 0.63 CHF (US)
- Johnson (2015): 0.28 CHF (US)

Pooled AVs (*per passenger kilometre)*

- Stephens et al. (2016) 0.14 – 0.19 CHF (US)
- Friedrich and Hartl (2016) 0.17 CHF (DE)
- Hazan et al. (2016) 0.10 CHF (NL)

Considering different vehicle types

www.renault.ch/de/renault-modellpalette/elektroauto-modellpalette/twizy

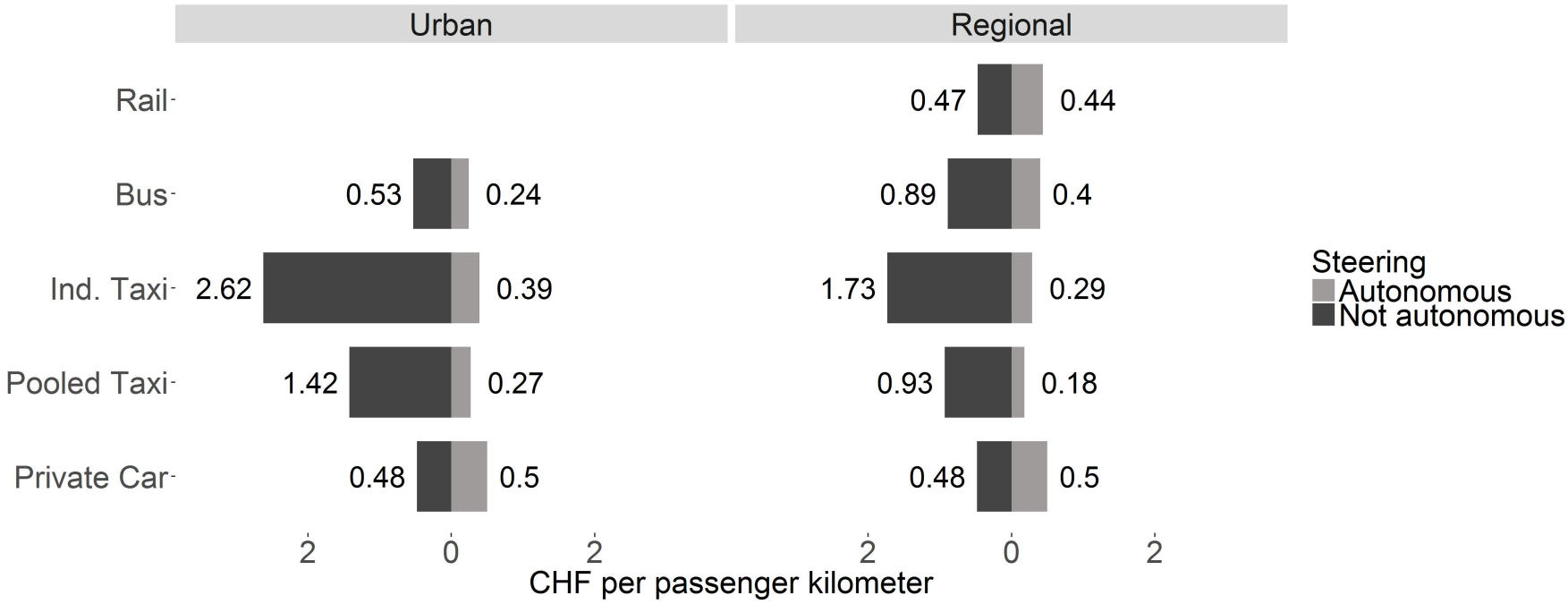
www.volkswagen.de/de/models/golf.html

www.volkswagen-nutzfahrzeuge.de/de/modelle/multivan.html

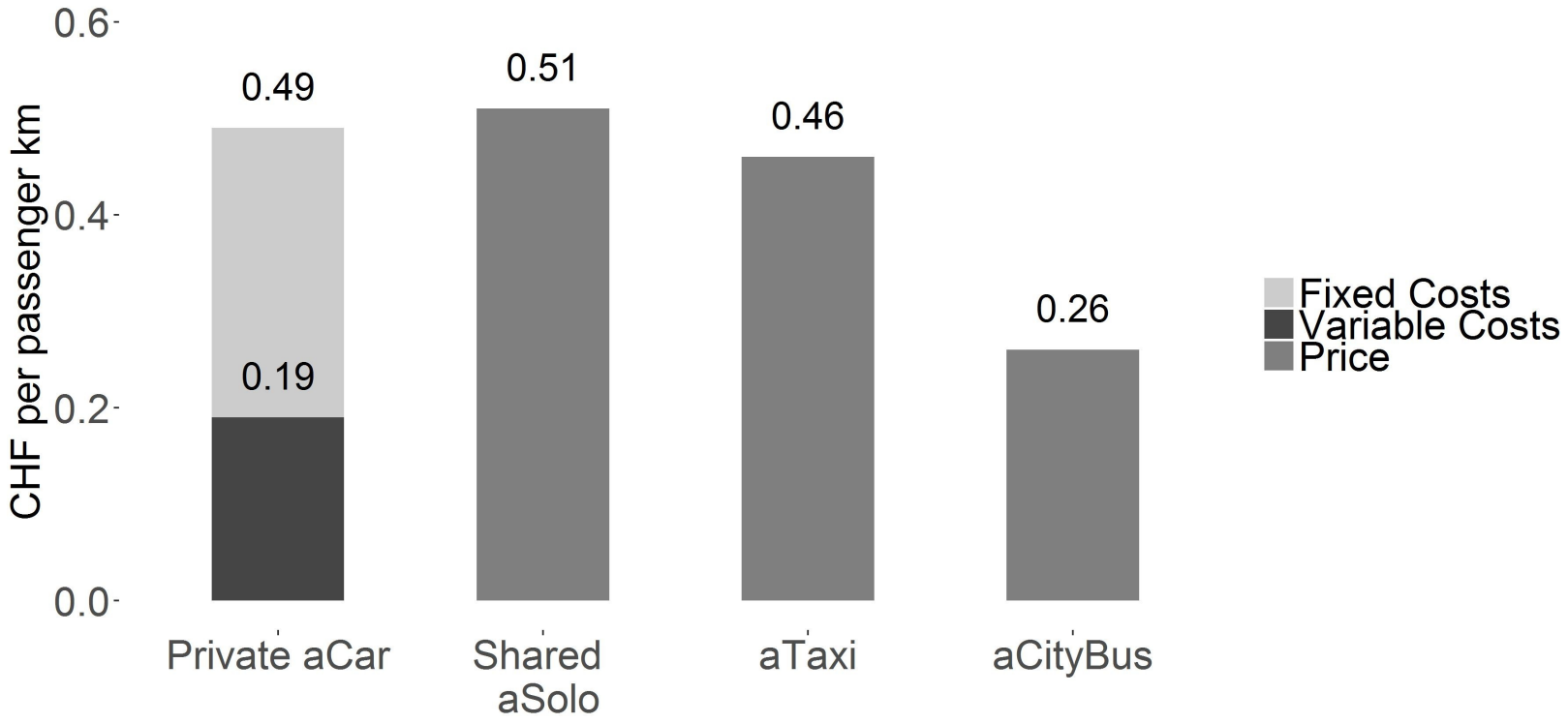
www.greateranglia.co.uk

www.metrotransit.org/bus

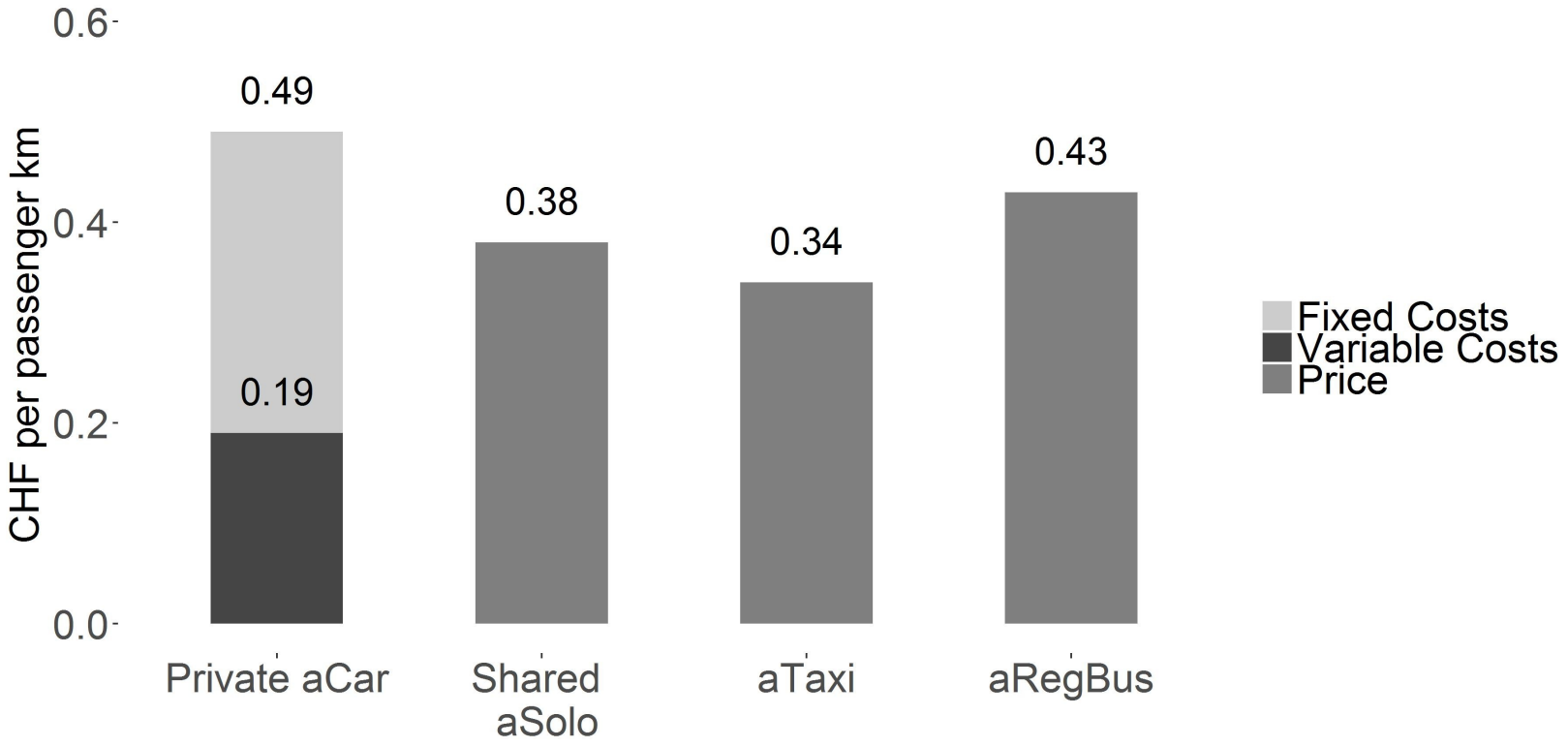
Cost situation: Non autonomous and autonomous



Automated and electric – urban setting



Automated and electric – regional setting



Conclusions

Cost-wise...

- AVs are more attractive than current services
- private car ownership will remain attractive
- line-based public transportation will remain viable for high-demand relations
- (shared) taxis will replace line-based public transportation on low-demand relations

Literature

Burns, L. D. (2013) Sustainable mobility: A vision of our transport future, *Nature*, **497**, 181–182.

Fagnant, D. and K. Kockelman (2015) Dynamic ride-sharing and optimal fleet sizing for a system of shared autonomous vehicles, paper presented at the *94th Annual Meeting of the Transportation Research Board*, Washington DC, January 2015.

Friedrich, M. and M. Hartl (2016) MEGAFON - Modellergebnisse geteilter autonomer Fahrzeugflotten des oeentlichen Nahverkehrs, *Research report*, Universität Stuttgart, Institut für Strassen- und Verkehrswesen, Stuttgart, Dec. 2016.

Hazan, J., N. Lang, P. Ulrich, J. Chua, X. Doubara and T. Steens (2016) Will autonomous vehicles derail trains?, *bcg.perspectives*, September 2016.

Johnson, B. (2015) Disruptive mobility, *Research Report*, Barclays.

Stephens, T., J. Gonder, Y. Chen, Z. Lin, C. Liu and D. Gohlke (2016) Estimated bounds and important factors for fuel use and consumer costs of connected and automated vehicles, *Technical Report*, National Renewable Energy Laboratory, U.S. Department of Energy, Golden, CO, Nov. 2016.

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Predicting the operating cost of the new services

1. **Bottom-up determination of vehicle costs**
   - fixed cost (per day)

(acquisition, insurance, tax, parking, overhead, ...)

   - variable cost (per km)

(depreciation, maintenance, cleaning, tires, fuel, ...)

1. **Including the effect of vehicle automation and electrification**
   - on the individual cost components
   - based on earlier research and assumptions

1. **Test different parameters for vehicle utilization**
   - based on current bus and taxi operations and results from agent-based simulation

(empty rides, occupancy, active time, kilometers driven, ...)