

An Integrated Accessibility-Affordability Indicator for Transport Vulnerability

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Extended Abstract

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Abstract Summary

Transport vulnerability is increasingly recognised as a multidimensional problem in which time and monetary constraints interact to limit households' access to opportunities (Lucas et al, 2016). Yet most empirical assessments treat accessibility and affordability as separate dimensions, missing the joint burden that arises when both constraints are merged. This paper develops the Generalised Expenditure on Transport Relative to Income (GETRI), an indicator that integrates monetary cost and the opportunity cost of travel time (Becker, 1965) into a single measure relative to household income. This framework provides a replicable, data-driven basis for spatially differentiated transport policy and for assessing the distributional impact of transport policies.

Based on mobile phone data, we compute the generalized cost of transport for both public and private transport in the Madrid Functional Urban Area (195 spatial units, over six million inhabitants). Our framework produces three main findings. First, low-income households incur in higher absolute transport costs than wealthier ones, driven by residential location rather than time valuation: peripheral areas with weaker public transport coverage generate longer, more expensive trips regardless of mode. Second, this measure relative to income reveals a double penalty in which higher absolute costs and lower income reinforce each other. Third, as income declines and peripherality increases, the gap between public transport and car effort widens, with the car becoming the most expensive option and leaving out-of-region households in a modal trap where neither option is affordable. A population-weighted distributional analysis shows that between 5% and 8% of the metropolitan population, depending on the mode, faces transport effort above twice the population-weighted mean.

Presenting Author Biography

Professor of Industrial Engineering at the ICAI School of Engineering, Director of the bp Chair for a Sustainable Net Zero, and co-founder and Director of Economics for Energy. I am also a researcher at the Institute for Technology Research (IIT), Affiliate Researcher at the MIT CEEPR and the U. Cambridge EPRG, and Senior Fellow at Esade EcPol. Currently I serve as Director of the International Doctoral School of Comillas Pontifical University, and as Editor in Chief of The Energy Journal.