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Transport Sector Emissions and Urban Development: Econometric Evidence from 100+ Countries

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Abstract

Background and Motivation:

The transport sector contributes approximately 24 per cent of global energy-related CO₂ emissions while urbanisation accelerates across the developing world at unprecedented speed. Despite this, the econometric literature linking transport-sector emissions to multi-dimensional urban development outcomes across a large cross-country panel remains limited. This paper addresses that gap.

Methods:

Using an unbalanced panel of 112 countries over 2000–2022 drawn from the World Bank World Development Indicators, IEA Energy Statistics, and the Global Carbon Project, this study employs Two-Way Fixed-Effects regression, System-GMM (Arellano and Bover, 1995; Blundell and Bond, 1998), and 2SLS estimation. Urban development indicators examined include urban population share, infrastructure investment per capita, and urban GDP density. Heteroskedasticity-robust standard errors are clustered at the country level, preceded by cross-sectional dependence and slope heterogeneity diagnostics.

Principal Findings:

A 10-percentage-point increase in urban population share raises transport CO₂ per capita by 1.8–2.3 per cent in low-income countries but reduces it by 0.6–0.9 per cent in high-income economies, confirming a strong income-conditioned agglomeration effect. Motor-vehicle density is the dominant driver of transport emissions intensity, with a System-GMM elasticity of 0.74. Urban infrastructure investment exhibits a significant negative long-run relationship with transport CO₂ intensity, supporting the infrastructure-efficiency hypothesis. A one-percentage-point increase in alternative-fuel vehicle share reduces transport CO₂ intensity by approximately 0.22 per cent. Results are robust to outlier exclusion, alternative fixed-effects specifications, and geographic and institutional instruments.

Policy Contribution:

Findings offer policymakers actionable evidence on which urban management levers most effectively decouple economic urbanisation from transport carbon intensity across diverse income contexts.

Keywords: Transport Emissions; Urban Development; Infrastructure Efficiency; Panel Econometrics; Carbon Intensity