

## 論文の内容の要旨

### 論文題目

# **RE-EXAMINING THE BUILT ENVIRONMENT-TRAVEL BEHAVIOR CONNECTION: A CASE STUDY OF JAPANESE CITIES**

(都市の物的環境と交通行動の因果関係に関する研究

-日本の諸都市を事例として-)

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The connection between the built environment and travel behavior has been the object of interest of a considerable number of studies in the past twenty years. As concepts such as Smart Growth, Compact Cities and New Urbanism permeate the sustainability discourse, the validity of the argument that high density, compact and mixed-use cities might reduce car use and promote the use of alternative modes hinges on the existence of a true causal mechanism between the built environment and travel behavior.

Of particular importance to the establishment of this causal mechanism is the issue of residential self-selection, where individuals choose their residential location partly to meet their transport preferences. In that sense, failure to control for self-selection might results in biased and inconsistent estimators of the true effect of interest. Although a great number of studies have established significant statistical associations between the built environment and travel behavior, establishing a causal relationship hinges on stronger conditions that are sometimes difficult to meet outside an ideal randomized experiment. This study uses data from several Japanese cities to test the existence of this causal relation using both panel and cross-sectional data.

From a panel data perspective, data from a survey on new-movers to a high-density, mixed-use development in the Kashiwanoha area in Chiba prefecture is used to estimate the effect of changes in the built environment on changes in travel behavior. Findings suggest that a positive change in the number of potential activity opportunities within one's neighborhood results on average in positive changes in the frequency of non-work activities conducted nearby and reached by non-motorized modes. Conversely, it also results in negative changes in the frequency of non-work activities conducted faraway by car. In other words, findings suggest the existence of a causal mode substitution mechanism between nearby activities reached by non-motorized modes and faraway activities reached by car for some non-work activities.

The rest of the dissertation then focuses on the problem of establishing causality using cross-sectional data, which is more widely available in the planning and transport fields. As a first step, significant statistical associations between the built environment and travel behavior are established using data from the 4th Nationwide Person-Trip Survey. Once statistical associations are established, the conditions for establishing causality using cross-sectional data are discussed, and a methodology to estimate causal effects is implemented and validated using data from independent surveys in the cities of Hiroshima and Fukuoka.

The implemented methodology, namely, a propensity score approach with continuous treatments, differs from previous applications in the planning literature in that it relaxes the binary treatment assumption which polarizes the built environment into two extremes (e.g. urban vs suburban), thus allowing for a more precise understanding of the built environment effect on travel behavior at all levels of the urbanization spectrum. The effectiveness of the proposed methodology in reducing bias against OLS was validated via Monte Carlo simulation using several data generating processes. Model results suggest that an increase in urbanization level –as measured by a newly-developed composite index of urbanization– has a negative effect on non-work home-based car trip frequencies, and conversely, a positive effect on non-work home based non-motorized trip frequencies. Similar to panel data findings, results estimates suggest the existence of a causal mode substitution mechanism between car and non-motorized modes given increases in the urbanization level at residential location, thus providing some empirical support to the arguments put forth by compact city advocates.

**Keywords:** *Travel behavior, Built Environment, Residential Self-selection, Causal Relationship, Urbanization Level, Fixed-Effect Models, Treatment Effect, Propensity Score, Continuous Treatment, Monte Carlo Simulation.*