The influence on land use and commuting conditions by the Tohoku Through Line

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Abstract

The Tohoku Through Line project is a three-span extension of rail service in the center of the Tokyo area. Nonetheless, the economic effects of this project have widely spread to northern suburban areas too. Our research quantitatively evaluates the effects by regions. This methodology contributes to decision-making and comparison of alternatives when there is a need for assessment of similar rail development projects in metropolitan areas.

Introduction

The huge urban rail transport network in the Tokyo Metropolitan Area, one of the biggest rail networks in the world, supports the economic activities of Tokyo's citizens. Reforms in this network can improve not only transport conditions but also the geographical distribution of residences and businesses. The East Japan Railway Company has been developing a new rapid route called the "Tohoku Through Line" between Ueno and Tokyo in order to shorten travel time from the northern suburban area to the central business district of Tokyo. Although this reform is small in terms of distance, the commuting conditions are expected to change drastically. This study analyzes the impacts of the reform project of the rail network on the regional economy by using a computable urban economic model.

Methodology and analysis

Our approach is based on the Computable Urban Economic model (Ueda et al., 2013), which illustrates the interaction between the land market and transport network flows (see Figure 1).

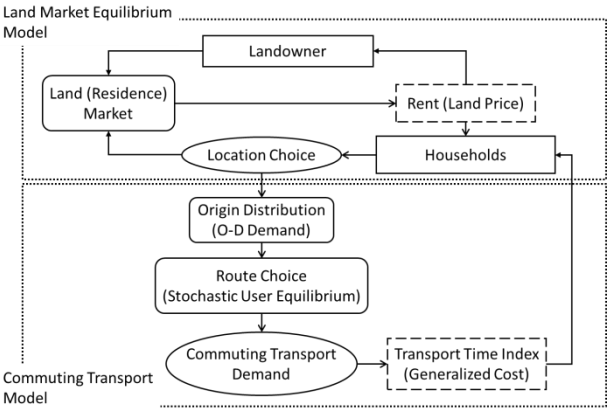

Figure 1: Structure of the Model

The model consists of two components: the land market equilibrium model and the commuting transport model. Profit maximization by landowners and utility maximization by households provide the equilibrium land rent and land demand distribution of households in the land market equilibrium model. The outputs of the land market equilibrium model form the predetermined inputs of the commuting transport model in the form of trip origin distribution. The commuting transport model estimates the commuters' flow on the rail network by solving the stochastic user equilibrium problem and computing the transport time index between every region-pair as the weighted average of the transport times of the chosen paths. The transport time index also forms the input of the land market equilibrium model, which influences location choice of the households. Through iterative convergence calculation, the overall model eventually provides the equilibrium rent of land, the geographical distribution of land demand by households, the commuting transport pattern, and the welfare index of each region for the exogenous transport time condition of the urban rail network. We can estimate benefits by region, as well as changes in the direct outputs of the model, by using the solutions of the "with project" and the "without project" cases.

We apply the model to the actual urban rail network in the Tokyo Metropolitan Area. The specific policy scenario is the extension of the terminal station for the northbound rapid service from Ueno Station to Shinagawa Station, through Tokyo Station. This project has added only three stations to the rapid rail route and has shortened about 10 minutes of commuting time for citizens living north of Tokyo.

Figure 2 shows selected results of our analysis, of locational change of households' residence, and benefits per capita. The colored Y-shaped area denotes regions where the new rail line has directly influenced access conditions to the Central Business District (CBD); this placed as the target of analysis. The results imply that larger benefits and changes will arise in suburban areas in the northeast and northwest, rather than in the CBD of Tokyo. Our analysis furthermore estimates changes in land rent, commuting transport flows, regional income, and so on.

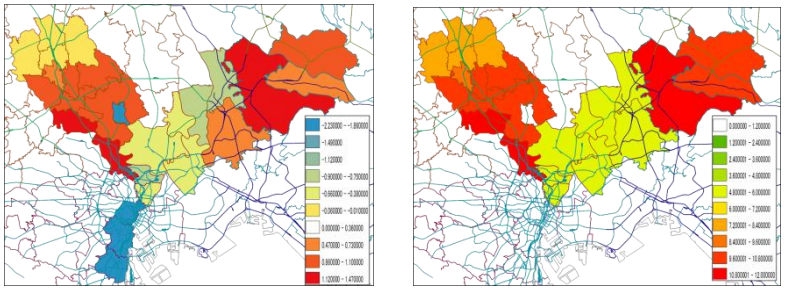

Figure 2: Change in location (LHS) and benefit per capita (RHS)

References

Ueda, Takayuki., Tsutsumi, Morito., Muto, Shinichi. and Yamasaki, Kiyoshi., 2013. Unified Computable Urban Economic Model, The Annals of Regional Science vol.50, issue 1, pp.341-362.