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The diversification of railway companies: Urban land use equilibrium analyses

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Abstract

This study shows the effects of the diversification of railway companies into real estate business on their primary business and the growth of commercial areas along railway lines. Methodologically, a model that combines the urban land use equilibrium model with the optimal train operation problem is formulated and the results of the numerical simulations suggest that the railway company should diversify into real estate in order to expand the retail market whose goods have property of cumulative attractiveness.

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Keywords: Diversification of railway companies; Urban land use equilibrium; Agglomeration economies; MPEC

1. Introduction

Private railway companies play an essential role in expanding high-density and productive land use in major Japanese cities. Such diversified companies not only lay rail tracks and run trains but also develop accompanying commercial facilities (e.g., retail and financial businesses, hotels, travel agencies, entertainment venues) and residential areas to meet the needs of the people living along railway lines. Furthermore, they play a considerable role in earning enough profits to secure their futures as private companies without public subsidies, which is rare in the world. Shoji (1993, 2001), by collecting data on the status of major private railway companies in Japan,

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concludes that their success is based not only on high demand density in Japanese urban areas but also on self-directive management policies and business diversification[1].

In this study, we focus on the diversification of railway companies such as developing commercial facilities along railway lines. To illustrate the participation of private railway companies in the growth in such commercial areas through their diversification into real estate, a standard urban land use equilibrium model is combined with an optimal railway operation problem. Then, the mechanisms that provide synergy effects related to the diversified real estate businesses of railway operations are investigated thorough numerical simulations.

By considering the differentiation of retail goods and diversified business of a railway company, the model proposed herein is extended as an optimization problem of train operations restricted by the urban land use equilibrium model. The structure of the problem, commonly known as an MPEC (mathematical problem with equilibrium constraints) or Stackelberg equilibrium problem, allows us to analyze the effects of adjustments in train operations by railway companies. Two cases—one of a railway company that only operates trains and the other of a company that also runs a real estate business—are analyzed by using comparative statics. Furthermore, to clarify the types of retail businesses that should be targeted by the diversification of railway companies, the cumulative attractiveness of retail shops is evaluated.

2. Literature Review

Anas (1984) integrated the transport network equilibrium model with the urban land use equilibrium model, consistent with urban economics theory. He then applied random utility theory to understand the connection between urban land use and transport choice. Miyagi et al. (1995) reformulated the Lowry-type land use model in accordance with random utility theory, unifying the model as transportation network flows and urban land uses that reach the equilibrium simultaneously. Subsequently, Miyagi and Sawada (2002) analyzed the impacts of different urban transportation strategies on urban land use.

Mun (1995) investigated location patterns and social welfare in land markets of the retail industry by applying a location equilibrium model that takes into account the behavior of standard economic agents such as customers, retailers, developers, and landowners. This study considered the positive externality of the accumulation of retail shops and discrimination by an oligopoly of large-scale retail shops. Furthermore, Mun (1997) extended this model, consistent with general equilibrium systems, and investigated the behavior of a system of cities connected by a linear transportation network, including several industries and economies of scale. Finally, Suzuki (2013) analyzed differences in urban land use depending on advanced railway services (e.g., direct services and rapid services) based on Mun's (1995) urban land use equilibrium model and by using numerical simulations. This study found that the change of railway network (e.g., hard infrastructures and soft train operations) differentiates urban land use in various ways.

3. Urban land use equilibrium model of railway lines

3.1. Consumption behavior of residents

We make the following assumptions about the consumption behavior of residents. All residents live along a railway line. They visit the retail shops near local railway stations several times during a given time period. Each resident chooses an area independently for each shopping trip. Their utilities are associated with cumulative attractiveness, expense, time cost, and their place preference. The utility gained by a resident living in area i and shopping at area j is given by

[1] In addition, real estate businesses that build residential properties and commercial facilities contribute heavily to the sustainable growth of railway business by (i) increasing passengers, (ii) fostering cost savings through the effective use of management resources, and (iii) internalizing the development benefits of advance land acquisition.