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RESEARCH ARTICLE

# Effects of land and building usage on population, land price and passengers in station areas: A case study in Fukuoka, Japan



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## Abstract

This study uses multiple regression to investigate the effects of land and building use on population, land price, and passengers. Initially, we abstract annual data on land and buildings usage within a radius of 0 m-400 m for railway stations and 400 m-800 m for subway stations in Fukuoka, Japan by using the GIS. We then analyze the relationships between 13 factors of land use and 8 factors of building usage, as well as the related population, land price, and passengers using the quantitative expression method. Using several categories of land use and building usage as explanatory variables, we analyze the degree to which the selected categories affect population, land price, and passengers by using the multiple regression method. This research can aid the further development of land and building usage in the future.

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## 1. Introduction

### 1.1. Background

The rate of increase in the number of cars in the city is much higher than the development of road traffic infrastructure with the development of social economy and rapidly increasing urbanization. Urban rail traffic construction has thus entered into a high-speed development stage.

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The road transportation system is burdened by the increasing number of urban cars. Vehicle emissions, such as carbon monoxide, hydrocarbons, nitrogen oxides, and photochemical products are harmful to residents' health. Buildings replace the ecological environment. As a result, traffic congestion, lack of parking space, environmental degradation, and so on, have become common in cities.

Almost all countries have prioritized the development of public transport, thereby creating experiences worth sharing. The United States and Europe have focused on automobiles to the detriment of public transport. The excessive pursuit of individual actions and the correct direction of sustainable development are lessons worth using as reference. Having urban rail transit as the backbone of urban public transportation and regular public transportation as an auxiliary system is generally considered the only feasible means of solving the urban traffic problem. Urban railways and subways are safe, comfortable, convenient, fast, effective, and environment-friendly urban infrastructure systems and reduce problems faced by many cities, such as shortages in land resources, traffic congestions, and air pollution. The quantified effects of rail transit development on land and building usage in adjacent areas must be examined to establish the effects of rail transit development on the population, land price, and the usage of adjacent land.

The theory of land use has been extended to address the dynamics of urban growth and decline. This extension has fundamental implications. First, the determinants of urban spatial structure vary between static and dynamic models. For example, in a static mono-centric model, lot sizes increase and densities decrease as distance from employment increases, because equilibrium land rents decline to offset the rising cost of commuting. However, in a dynamic model with durable housing and myopic landowners, urban development is an incremental process, where densities depend solely on the economic conditions at the time of development. Densities may nevertheless decline with distance, because economic conditions change over time in particular ways (incomes increase or transportation costs fall), but land rent and selling prices and population densities may also rise with commuting distance.

An increasing number of buildings are being built as a result of the rebuilding of stations with the development of land readjustment and buildings along stations in Fukuoka city. Areas along railway tracks have thus changed rapidly. Recently, residential areas have gradually appeared in the center of the city, despite the tendency of resident to transfer to the suburbs. Furthermore, modern society still develops around public traffic; peripheral urban development centers on train stations are thus expected to become increasingly important to city planning centered on public traffic in an environmental society. With the development of large-scale retailers and specialty stores, the shutter streets of shopping streets have become increasingly serious. A shutter street is a street with various branch shops and closed-down shops or offices. Such areas used to form a busy shopping district with the taste of a "commercial town", but with the shops closing down, the area is now mostly residential.

The Fukuoka-based Kyushu Economic Research Center has reported that more people left the Kyushu-Okinawa region

than moved into the area in 2012, resulting in the first excess outflow of population in two years. The 4860-person drop was attributed to a decline in the number of people moving in from regions affected by the Great East Japan Earthquake and nuclear power plant incident, coupled with an increase in the number of people moving back to those regions in connection with disaster reconstruction efforts. Aside from Fukuoka and Okinawa, every prefecture in the region experienced excess outflow, led by Nagasaki and Kagoshima, with respective declines of 4906 and 3599 persons. Fukuoka experienced an inflow of 9221 persons, with over 60% of the new population originating from the Kyushu region (Source: Nishinippon News).

## 1.2. Previous studies

Over the years, researchers have introduced a large number of developments in railway and subway stations, and have examined the relationship between urban land and stations as well as the varying importance of stations in a city based on one criterion or another. The studies described in this section have proven highly valuable in the analysis and understanding of the roles played by railway and subway stations in the development of a city, such as the theory of rail transit and its development, effects on land market, the influence on house price, the developing situation in terms of land and building usage, analysis of changes in land price and house price, and so on. Given the three main elements supporting this paper, the previous studies are shown in turn.

Sustainable development and livable communities represent broad visionary ideas in contemporary urban planning. However, attempts to implement these popular visions face a host of conflicts. The future of land use planning may well depend on how to cope with these conflicts (Godschalk, 2004). Wang and Yu (2012) examined the characteristics of urban landscapes following a temporal-spatial pattern that provides a reference for the characteristics of land use in the temporal-spatial pattern. The influence of transit-oriented development (TOD) on the San Diego, CA condominium market indicates that TOD has a synergistic value greater than the sum of its parts. This result also implies a healthy demand for additional TOD housing in San Diego (Duncan, 2011). Kim (2010) examined how land use planning and regulation may affect regional economic prosperity by reviewing the relevant literature. Handy (2005) noted a connection between transportation and land use. Kestens et al. (2006) introduced household-level data into hedonic models to measure the heterogeneity of implicit prices based on the household type, age, educational attainment, income, and previous tenure status of the buyers. Hess evaluated the influence on the distance from Buffalo, New York to light railway stations on housing price. After using price models to assess the housing prices of 14 light rail spots, Hess concluded that for each foot away from the light rail station, the average value of the house increased by \$2.31 or \$0.99 according to linear distance calculations (Hess, 2007). Cohen and Paul (2007) evaluated the effects of enhanced transportation systems on property values. Ryan (2011) reviewed the relationships among transportation facilities, highways, heavy rail, and light rail transit systems and

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