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“Technical Research and Development for Road Policy Quality Improvement” Study Summary

No.	Title	Principal Researcher
2020-2	Research on the evaluation of spatial economic impacts of building bus termini	Kanazawa Univ. Assoc. Prof. Yuki Takayama

This study presents two approaches to quantify the spatial economic impacts of building bus termini. The first approach evaluates the effects on traffic congestion and land use, while the second one assesses the spillover effects on the surrounding regional economies. By applying these approaches, we measure the impacts of terminal development in Sapporo and Kanazawa.

1. Backgrounds and Objects

The development of public transportation termini has long-term and wide-ranging impacts on urban spatial structure and regional economies. Therefore, it is important to accurately assess these effects to ensure effective and efficient implementation of such development. This study proposes two economic approaches to quantify the spatial distribution of long-term effects associated with terminal development. Furthermore, we measure the spatial economic impacts of building bus termini in Sapporo and Kanazawa.

2. Activities in Research Period

In this study, we set the following three research tasks [A, B, C] and successfully achieved our objectives by implementing them sequentially.

[A] Development of an approach to quantify the effects on traffic congestion and land use

We devised an approach that integrates land use and transportation models to quantify the impacts of public transportation terminal development on traffic congestion and land use. Through numerical experiments, we validated its consistency with the long-term changes in the spatial structure of Japanese cities.

[B] Development of an approach to assess the spillover effects on regional economies

We extended a spatial computable general equilibrium (CGE) model to develop an approach for evaluating the spatial economic impacts of terminal development. We confirmed its ability to capture the agglomeration of economic activities observed in Japan.

[C] Measurement of the effects of public transportation terminal development

Using the approaches developed in tasks [A] and [B], we measured the long-term and wide-ranging effects of bus terminal development in Sapporo and Kanazawa.

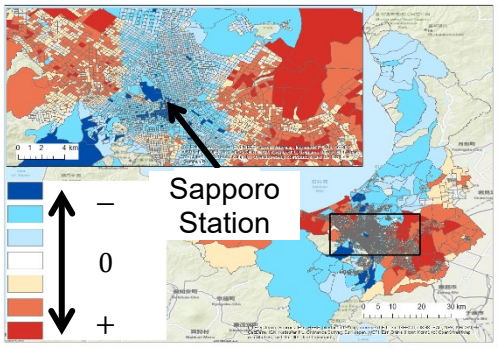
3. Study Results

The findings from the research tasks [A, B, C] are summarized as follows:

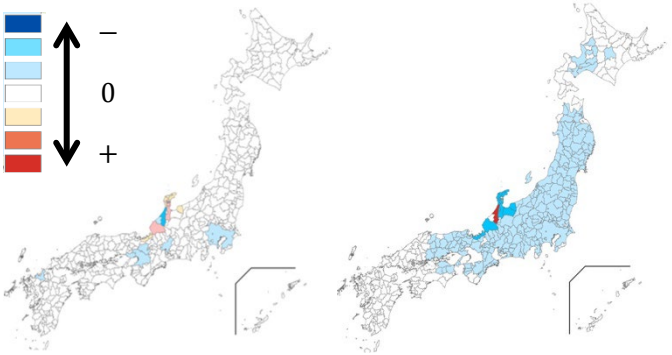
[A]: We have made significant progress in improving the computational efficiency of numerical analysis required to assess the impacts of building bus termini. Additionally, we have developed a method for parameter estimation and calibration using readily available data. Through a preliminary analysis, we have demonstrated the feasibility of the developed approach for analyzing large-scale, high-resolution urban and transportation systems. Furthermore, we have examined the impact of uniform decreases in transportation costs on land use, which aligns with observed changes in population distribution in Japanese cities.

[B]: We have developed a spatial CGE model based on quantitative spatial economics and devised parameter estimation methods that utilize easily accessible transportation and economic data. Moreover, we have introduced an algorithm for conducting counterfactual analyses. In a preliminary analysis, we have evaluated the effects of intercity transportation improvements, confirming that the framework accurately captures the observed economic agglomeration in Japan.

[C]: Leveraging the approaches developed in tasks [A, B], we have investigated the effects of building bus



Residential population changes in Sapporo



Population (left) and GRP (right) changes when the terminal is developed in Kanazawa

Figure: Examples of terminal development impact

termini in Sapporo and Kanazawa. As shown in the figure above, we have successfully measured and visualized the impacts on land use within the cities, as well as on population and gross regional product (GRP) in the surrounding regions. Furthermore, our analysis has revealed that the effects vary qualitatively depending on the location of the terminal development and can be negative for the developed areas.

4. Papers for Presentation

- Dantsuji, T., **Takayama, Y.**, Fukuda, D. (2023) "Perimeter control in a mixed bimodal bathtub model," *Transportation Research Part B: Methodological*, Vol.173, pp.267-291.
- Sugimoto, T., Takada, M., **Takayama, Y.**, Takagi, A. (2023) "Development of a long-run impact assessment methodology for interregional transportation improvements based on spatial economics," *Japanese Journal of JSCE*, Vol.79, No.4, 22-00115.
- Murakami, D., Griffith, D.A. (2023) "Balancing spatial and non-spatial variation in varying co-efficient modeling: A remedy for spurious correlation," *Geographical Analysis*, Vol.55, pp.31-55
- Kobayashi, S., Nakanishi, W., Horikoshi, H., **Takayama, Y.** (2022) "Bayesian estimation of a land use model," *Journal of Japan Society of Civil Engineers, Ser. D3 (Infrastructure Planning and Management)*, Vol.77, No.5, pp.469-481.

5. Study Development and Future Issues

Throughout our research, several challenges have emerged that require attention and further exploration:

Accumulation of diverse policy impact verifications: The framework developed in this research has effectively addressed existing limitations in previous methods. These limitations include the inability to capture observed economic agglomeration in Japan and the limited spatial resolution of analyses. Our approaches have the potential to serve as foundations for predicting the spatial distribution of long-term and wide-ranging effects of various policies. However, in order to enhance their reliability, it is crucial to accumulate more case studies and refine the frameworks.

Cost reduction for data collection: The evaluation of spatial economic impacts requires the collection of data related to geography, regional economies, and transportation. However, the cost associated with acquiring such data is substantial. In order to facilitate the accumulation of case studies and promote wider implementation, it is important to address this challenge by exploring cost reduction strategies and innovative data collection methods.

6. Contribution to Road Policy Quality Improvement

Our research has made significant advancements in measuring the long-term and wide-ranging effects of policies, which is expected to contribute to the improvement of road policies. Our approaches not only facilitate the measurement and evaluation of the effects of building bus termini but also provide a basis for assessing diverse long-term effects (referred to as "stock effects") and wider economic impacts.

7. References, Websites, etc.

None.