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

No.	Title	Principal Researcher
No.28-3	Reconstruction of Measurement Technique in Stock effect of Road Infrastructure Using Multiple Big data	Hiroshima Univ. Prof. Makoto TSUKAI

This study conducts a traffic accident analysis using traffic state indices obtained from ETC2.0, a travel cost approach for sightseeing spot using mobile phone data and a hedonic approach in industrial site, in order to reconstruct a measurement technique in stock effect of road infrastructure.

1. Backgrounds and Objects

Since the existing structure of economic activities is supposed to be identical in a current stock effect measurement, the methodological limitation of stock effect measurement appears. This theme purposes to propose new stock effect measurement technique using novel transportation big data such as ETC2.0 or locational information by mobile phone. In case of big data use, existing classical statistic approach is not applicable because of novel statistical characteristics of big data. This theme develops a novel stock effect measurement techniques taking the advantage of multiple big data sources in transportation and land use.

2. Activities in Research Period

Theme 1 : Qualitative index for traffic state and traffic accident analysis

This study proposes a novel qualitative index for traffic state using ETC2.0. In this study, velocity and acceleration in ETC2.0 are aggregated to make a section / time database of them, which is called quality of traffic (QOT) index in this study. QOT can be utilized for “ease of driving of each road section” corresponding with number of lanes or road alignment. An odds ratio model is used for a traffic accident analysis.

Theme 2 : Travel cost approach in sightseeing spot

Locational information of mobile phone provided by NTT docomo is used to evaluate the value of destination following to travel cost approach. In this study, sightseeing spot database, passenger flow data by mobile phone data, and other land use characteristics are used as explanatory variables in statistic model for destination traffic.

Theme 3 : Hedonic analysis on industrial sites

Hedonic approach is based on the capitalization hypothesis supposing that the effect of infrastructure investment finally embedded in land price. This study conducts a hedonic analysis on industrial sites using locational information of mobile phone. As explanatory variable, the dataset in arriving traffic of industrial interaction obtained from mobile phone data is made. The obtained dataset is used for hedonic analysis of industrial sites along the interregional highway, then its effects on land price is analyzed.

Theme 4 : Inspection of stock effect of road by statistical approach (the additional theme corresponding with interim appraisal)

Ordinal economic model derives the model structure from optimization theory consisting with rational economic behaviors, but the model structure is merely extracted through the observed dataset. This theme tries to establish a novel approach to discover the potential causal relationship between economic performance indices and potential candidates of explanatory factors. For this purpose, statistic causal inference approach is referred.

3. Study Results

Theme 1 : Qualitative index for traffic state and traffic accident analysis

The distribution of velocity and acceleration on highway sections are considered as QOT index, these QOT are significant factors on traffic accident. This finding indicates that regulating the traffic flow at potentially danger section for traffic accident will decrease the occurrence of traffic accident. Also, the on-site monitoring of traffic flow will give some information about the location and traffic state with potential accident danger.

Theme 2 : Travel cost approach in sightseeing spot

Travel cost calculation in sightseeing spot can give the quantitative map of attractiveness of sightseeing spot,

which enables the visual monitoring of sightseeing spot. Since the travel cost approach can aggregate the travel cost at the destination side, transition of sightseeing spot in the target region and correspondence with locational characteristics are effectively clarified by this approach.

Theme 3 : Hedonic analysis on industrial sites

Hedonic approach clarified the significant factor to increase land price of industrial spots as follows; accessibility to highway interchange and the diversity of industrial traffic which have periodic peak on Friday, and at night. This finding is novel and precious in the hedonic approach considering inter-regional interaction. As a stock effect measurement of road, hedonic approach seems to be valuable and promising.

Theme 4 : Inspection of stock effect of road by statistical approach(the additional theme corresponding with interim appraisal)

In this theme, a causal discovery which is the latest version of statistic causal inference approach is applied to the dataset along the Onomich-Matsue regional expressway which started to operate in 2015. As an initial hypothesis on causation among the variables, social and demographic variables (i.e. population, workers and number of offices) influence on economic activities (land price and gross regional product), and accessibility index will influence on social and demographic variables or economic activities or both of them. As the result of analysis, accessibility index influences only on land price but on gross regional product. This is the first findings about the application of causal discovery to infrastructure stock effect measurement in the world.

4. Papers for Presentation

Sugihara, G and Tsukai, M. : Inspection of infrastructure stock effect by causal discovery, proceedings of infrastructure planning, vol.59, 2019

Tsukai, M., Yamamoto, W., Maruyama, T. Sato, K., Seya, H.and Shimamoto, H.: Transportation stock effect measurement by statistic approach, state of the art, proceedings of infrastructure planning, vol. 58, 2018.

Takayama, R., Tsukai, M., Yamamoto, W. and Yamamoto, Y.: A traffic accident analysis using ETC2.0 data, proceedings of infrastructure planning, vol. 57, 2018.

Yamamoto, Y., Tsukai, M., Yamamoto, W. and Oyamada, T.: Detection of the sections of driving velocity deteriorations with its related factors on local highway, Journal of Japan society of civil engineering D3, vol.74-5, I_693-I_702, 2018.

Shimamoto, H. and Kuroe, M.: Characteristics of locational information data by mobile phone toward the infrastructure stock effect measurement, proceedings of infrastructure planning, vol. 57, 2017.

Uda, S. and Seya, H., Tsukai, M. and Tsutsumi, M.: An analysis on transaction price on industrial site, proceedings of infrastructure planning, vol. 57, 2017.

Yamamoto, W. and Tsukai, M. : An Analysis of Vehicle Speed Distribution by Using Traffic Counter Big Data, THE 12 INTERNATIONAL CONFERENCE OF EAST, 2017.

5. Study Development and Future Issues

In the theme of QOT index and accident risk, an effective usage in the velocity and acceleration data in ETC 2.0 was developed. In terms of data processing of locational information of mobile phone, practical problems to extract the target traffics from the observation were found to be discussed further. Causal discovery and existing stock effect are studying with the researcher in Kobe university. Furthermore, the relationship with wider economic impact will be summarized.

6. Contribution to Road Policy Quality Improvement

Detection of the sections of driving velocity deteriorations with its related factors on local highway is easy to apply to the other sections, practical use are discussed with local staff of road administrating sector. The existing stock effect measurement technique and the proposed causal discovery will be continuously studied with the member of study stuffs in this research theme.

7. References, Websites, etc.

None.