SUMMARY

Assessing the Publicness of the Roadway Infrastructure and its Applications for the Policy Development.

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This study is to define the concept of publicness in terms of road infrastructure and to make an publicness indicator, and explores the way to utilize developed indicators for the government's roadway policy development. The concept of publicness is vague and is used in a various fields without a single unified definition, which resulted in the need to define the publicness based on the characteristics of road infrastructure. Through the literature reviews, the three main elements of the publicness (the subject, equity of distribution, fairness of procedure) could be identified, and finally, the publicness of the road infrastructure is defined, which represents the characteristics of the road infrastructure while maintaining the essential relationship of these key elements as follows.

"The opportunity for public participation in the supply decisions of the road infrastructure is fully guaranteed and the enhanced benefits are enjoyed by all users without discrimination."

The publicness of road infrastructure was developed as an indicator by focusing on the equity of distribution. The study decides to exclude the other components because road infrastructure itself is a public service which naturally pursues 'the subject' and 'fairness of procedure'. For example, opportunities for public participation, such as the preliminary feasibility study, public hearings for various impact assessments, and procedures for collecting public opinions through project briefings, were deemed to be devices that secure minimum procedural fairness. For the equity of distribution, which is divided into horizontal and vertical equity, this study reflects both in publicness indicator. In the meantime, the study provided the evidence that helps to determine whether the publicness of road infrastructure should reflect vertical equity at the level of social justice by examining the utilization rate of toll roads by income level of household.

The horizontal indicator is set to be the time of passage per unit distance (km) to the destination frequently visited by the user. This was to reflect whether road users are exposed to equal transport service for the desired spatial approach, and the vertical equity index was represented as the toll against the willingness to pay according to income level. This is to reflect the situation where the co-existence of the toll road and the free road may be discriminatory due to the user's economic conditions, which means that the financial status and geographical location of users and the spatial distribution of tolled and untolled road infrastructure should be considered at the same time. A significant difference in the financial status of users in a spatial distribution in which tolled roads provide a significantly higher mobility for users than untolled roads means a high imbalance in vertical equity. Those whose income level is high may feel less burdened by tolls and thus are more likely to use tolled roads than others in a low-income group, while those whose income level is low may feel

more burdened by tolls and thus may tend to use untolled roads despite longer travel time. To analyze these differences, it is necessary to analyze data on income level by region, differences in travel time caused by their different spatial distribution of tolled and untolled road infrastructure, etc.

In this study, vertical equity is expressed as the ratio of tolls to users' willingness to pay depending on the level of income. In each area, the time of travels to frequent destinations may differ depending on the road infrastructure configuration use of tolled and untolled roads, and when using tolled roads to save travel time, users have to pay tolls. In this case, the amount of tolls that users have to pay and their willingness to pay for tolls in the area depending on their income level are compared to express differences in vertical equity. Here, users' willingness to pay is estimated through a questionnaire survey on the value of travel time by income level, and is matched with the income level of the area to assume residents' willingness to pay in the area.

The vertical equity index used to express the concept above is calculated following the procedure below.

Step 1. Calculate the travel time and tolls of tolled and untolled roads for travels between areas within an analysis zone. To better reflect reality, the size of the unit analysis zone used in this study was set as 1km×1km. Travels between areas from each zone to other areas including other metropolitan cities or roads were targeted (top 10 destinations from each zone were selected for analysis). The travel time of tolled and untolled roads for travels between areas was calculated based on the routes that users are highly likely to choose using SK T-map that accounts for over the half of the navigation application market. Travel routes were searched and collected as of 10 a.m., May 19, 2019 using the time machine function of T-map API that users can fix the date and time of searching travel data.

Step 2. Calculate the amount of tolls that users are willing to pay depending on the income level of each analysis zone. The amount of tolls that users are willing to pay for tolled roads depending on the income level was estimated in this study through a stated preference survey. The surveyed amount of tolls that users are willing to pay was matched to the income level of each analysis target area to calculate the amount of tolls that users are willing to pay within the area.

Step 3. Measure the time value of tolls that have to be paid when using tolled roads. There are tolled and untolled roads from a target analysis zone to another zone, and when users choose to use tolled roads to save travel time, they have to pay tolls. Here, the tolls that have to be paid when using tolled roads are expressed as the value of time. That is, the amount of 'tolls' that occur within routes of tolled roads is divided by 'differences in travel time between using tolled roads and untolled roads' to calculate the amount of tolls that have to be paid per unit time (won/hr) when using tolled roads.

Step 4. Calculate the ratio of the amount obtained in Step 3 to the amount of tolls that users are willing to pay depending on the income level of a target zone. The ratio of travels from each zone to other metropolitan cities and roads is calculated and aggregated by zone.

This study contributed to statistically identifying the necessity of assessing vertical equity in road infrastructure users and developing an index that utilizes individual users' revealed data to reflect it. As the developed index used very microscopic data as variables based on users' choices of routes to better reflect reality, its resolution from the perspective of expressing reality is much higher than conventional zone-based indices used to assess users' equity.

This vertical equity assessment method is relatively simple and can be fully utilized as a tool for establishing policies. As a basic tool for analyzing vertical equity in road pricing, this can be usefully applied to analyzing vertical equity in road users in countries like Japan where tolls for highways are very high, and the United States where tolls are charged in the form of Turnpike and HOT.