Objectives and motivation

When subject to toll increase, freight carriers often adjust their behavior to mitigate the impact of additional operational costs. One of the potential behavioural responses for carriers is to change the delivery route and reduce mileage on toll roads. Understanding freight carriers’ route change behavior in response to toll increase is very important as it directly influences freight traffic and the consequent externality patterns. This study will investigate this issue using empirical data collected from New York State, USA. In the survey, each carrier first indicated whether or not they would change routes, and if yes, by how much they would reduce the mileage travelled. The carrier only answered the second question if they answered “yes” in the first question, resulting in a sample selection process.

Traditional sample selection models (Heckman 1979) assume independence among observations, which may cause problems in freight agents’ behavioral studies. In a competitive freight market, behavior of one agent often significantly influences their peers’ behavior, leading to interdependencies among agents. And intuitively, carriers serving adjacent locations, either adjacent origins (shippers) or adjacent destination (receivers), tend to have stronger influence on each other than those serving distant locations. In order to capture such interdependency effect, this study will develop a sample selection model with two successive spatial autoregressive filters, analyzing the spatial interaction at both the origin and the destination, i.e., a model with OD filters. The origin filter recognizes the fact that carriers serving neighboring shippers tend to have similar behavior, and the destination filter captures the spatial dependency in receiver end. The product of the two filters will further capture the spatial interaction caused by the delivery tour linking the two ends. In spatial econometrics, OD filters were first introduced by LeSage and Pace (2008), but limited to analysis of single regression equations. This study will extend this area by allowing analysis of behavioral data using multiple equations. The proposed model will be estimated using a Bayesian MCMC method because the likelihood function involves a multi-dimensional integral. The model performance will be evaluated by measuring the parameter recovery capability using simulated dataset before being applied to the empirical data.

With the rich information collected from the survey, this study will identify the connections between carriers’ route change behavior and their characteristics. The model will also quantify the magnitude of peer influence through the spatial OD filters.

General description

As the link between shippers and receivers, freight carriers’ behavior should be characterized by both origin and destination. Considering the interaction between freight carriers thus requires the consideration of both ends. This paper accommodates this feature by developing an innovative sample selection model with spatial OD filters. It investigates the spatial interaction at both the origin and the destination ends. The model will be estimated using Bayesian MCMC inference method and validated by a set of simulated dataset. Its application to the stated preference data collected from NYS, USA will provide important insights that enable a better understanding of carriers’ route choice behavior.

Results and conclusions

The innovative sample selection model with spatial OD filters will be specified, estimated, and validated in this paper. It will provide a solution that appropriately specifies the spatial interactions caused by freight flows. The effects of various influential factors will be estimated, such as carriers’ characteristics, market conditions, and spatial interactions.
References

Keywords: Behavioral Analysis; origin and destination filter; spatial econometric analysis.