

Modelling the impacts of COVID-19 measures on activity-travel behavior in the Netherlands: A MDCEV framework

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The COVID-19 pandemic has brought about substantial changes in people's activity-travel behavior. In the early phase of the pandemic (March 2020), the Dutch government implemented so-called "intelligent lockdown" to avoid the spread of the virus while minimizing the economic impact. Though it was not a complete lockdown, the measure included the cancellation of all leisure/social activities, the closure of catering/leisure facilities and schools, downscaling public transport, work-from-home as a norm, and so forth. As more data become available, some descriptive analyses have been undertaken. For example, recent studies analyzed the impact of the Dutch lockdown on activity-travel behavior. They both found a decrease in the number of out-of-home activities and travel distance, and more prominent decline in the use of public transport. However, modelling these changes is crucial in the context of preparing post-pandemic and possible similar future scenarios.

In this study, we used the Netherlands Mobility Panel (MPN) data collected during different phases of the pandemic to understand how people adapt their behavior with the implementation and relaxation of governmental measures. The MPN data is a longitudinal activity-travel diary data collected from a fixed group of approximately 2000 households since 2013. The data is collected annually based on a self-reported diary of 3 consecutive days. To model activity duration and mode-choice behavior, we estimate an episode-based mixed multiple discrete-continuous extreme value (MMDCEV) model. As daily activity-travel behavior can be characterized by the multiple discrete-continuous choices, MDCEV models have widely been used in transport literature. However, MDCEV in the seminal work usually focused on predicting behavior at a daily aggregate level (either time-use or mode-use). The episode-based approach proposed by Palma et al. does not aggregate the amount of consumption for each alternative but allows multiple episodes per activity.

Regarding activity time-use behavior, the result suggests a significant decrease in education, leisure and services along with increases in touring activity (e.g., walk a dog) during the lockdown period, but soon it recovered to the pre-pandemic state in the relaxation period. In terms of the satiation effect, all else being equal, during the lockdown period, people spent less time on business and education activity whereas home activity duration was increased. The episode-based approach enriches the behavioral insights. The number of episodes was significantly reduced during the lockdown period which also implies a decrease in daily travel. Most of the estimated penalty parameters for both baseline utility and satiation parameters have negative values indicating the fatigue effects on the repetition of the same activity type. For transport mode-use behavior, the use of public transport (train, bus/tram/metro) significantly dropped during the lockdown period while the use of active modes (walk, bike) is increased. Regarding the penalty parameters on mode-use, the results show somewhat different behavior compared to activity time-use. Several positive penalty parameters were observed indicating the fact that the most daily travel is round trip using the same mode. The association between socio-demographic attributes and activity-travel behavior is intuitive and is consistent with previously reported studies.

Keywords: COVID-19, Activity Travel Diary Data, Multiple Discrete-Continuous Extreme Value Model, Activity-Duration Choice, Mode-Duration Choice